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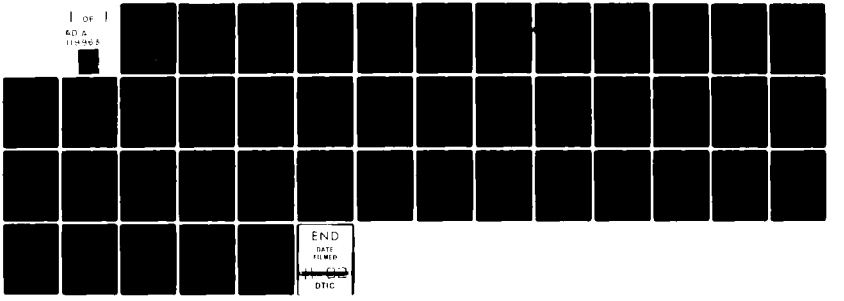

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AFGL-TR-82-0123

MEASURING THE ANTENNA PATTERN OF THE HF HEATER ANTENNA IN PUERTO RICO

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The radiation pattern of the 4 × 8 element array of the Arecibo HF heater antenna was measured with a Digisonde onboard AFGL's KC 135 airplane. With seven flight tracks over the antenna array at an altitude of 8840 m it was verified that the radiation pattern of the heater antenna is in good agreement with the calculations. The measurements were conducted at 5.1 MHz.

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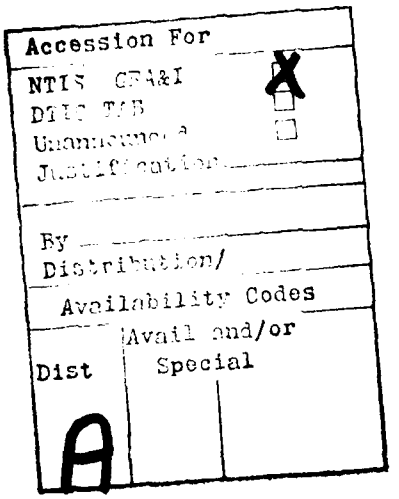

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1.0 INTRODUCTION

On 28 September 1981, the Digisonde onboard AFGL's KC 135 airborne ionospheric observatory measured the radiation pattern of the HF heater antenna located some 20 km north of the Arecibo Observatory in Puerto Rico. At an altitude of 8840 m (29,000 ft.) the aircraft flew seven tracks over the antenna array. The heater transmitter was generating 2 kW at 5.1 MHz.

2.0 THEORETICAL PATTERN OF THE HEATER ANTENNA

The theoretical pattern of the antenna array was calculated for a height of 29,000 ft. by W. E. Gordon and his colleagues at Rice University. The radiation pattern is described by Pattern = (Array Factor) * (Element Factor) * (Dipole Factor). The heater antenna contains four elements spaced at 85 m in the north-south direction giving an array factor of

$$\frac{\sin mx}{\sin x} = \frac{\sin [4(85\ \pi/\lambda)\ \sin\theta]}{\sin [(85\ \pi/\lambda)\ \sin\theta]} \qquad (1)$$

where

θ = zenith angle above antenna

λ = 58.8 m at 5.1 MHz.

Dr. Gordon suggested an element factor, derived from scale model pattern measurements, of the form

$$\cos \frac{4}{3}\theta. \qquad (2)$$

The dipole factor accounts for an additional 3 dB attenuation at the side lobes and is given by

$$(\cos \theta);\ \theta \text{ defined above.} \qquad (3)$$

In two dimensions (θ = zenith, α = azimuth) we have

$$A(\theta, \alpha) = \left(\frac{\sin mx}{\sin x}\right) \cdot \left(\cos \frac{4}{3}\theta\right) \cdot (\cos \theta) \cdot \left(\frac{\sin my}{\sin y}\right) \cdot \left(\cos \frac{4}{3}\alpha\right) \cdot (\cos \alpha) \qquad (4)$$

A map of the amplitude lobes for 5.1 MHz is given in Figure 1 and consists of one main lobe, side lobes and one pair of grating lobes. (Note these values have not been corrected for the increased range in the side lobes.) To verify the pattern it was decided to fly two north/south, two east/west and two diagonal tracks. The actual flight tracks, as deter-

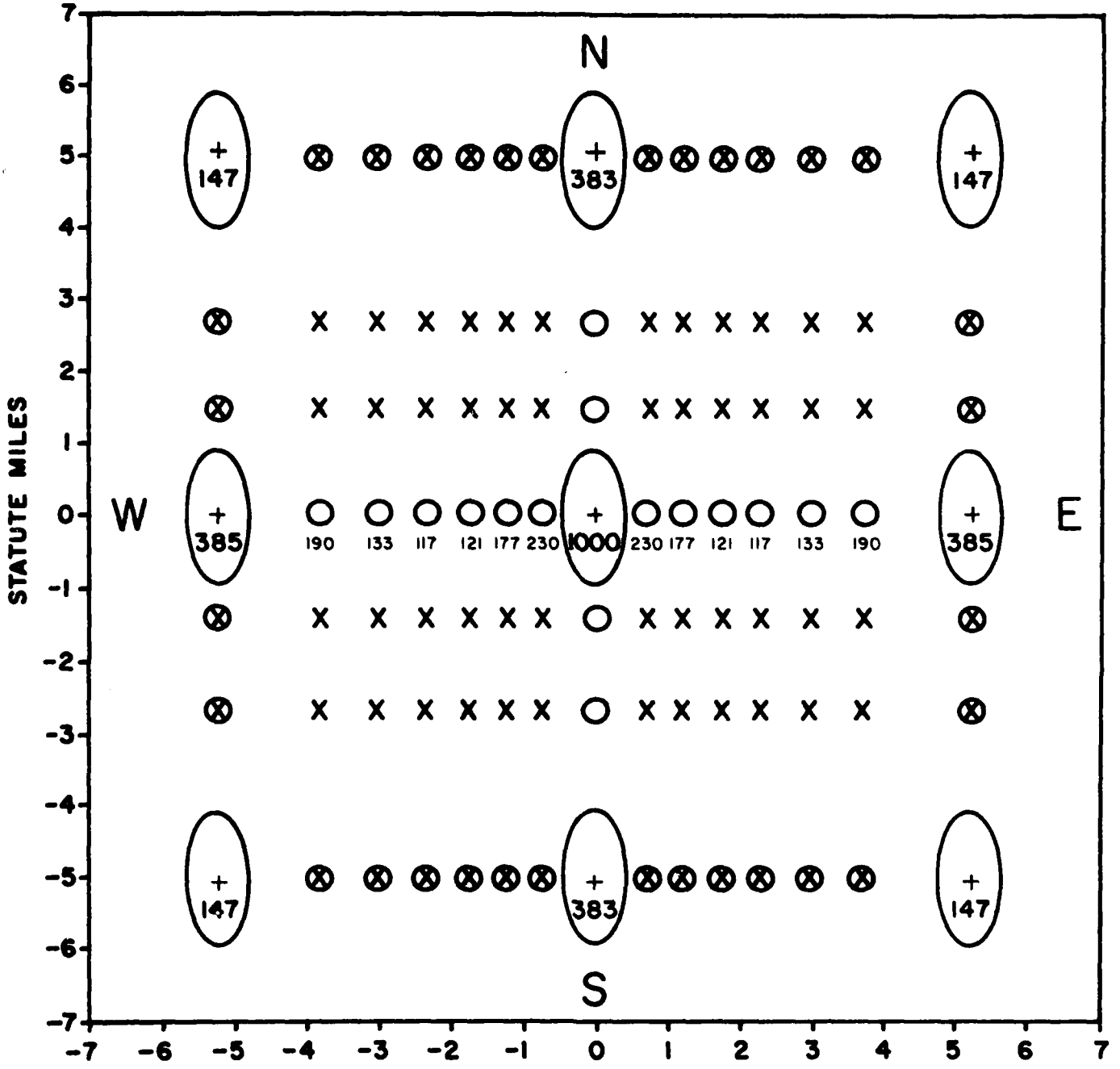

Figure 1. Arecibo Heater Beam (5.1 MHz, 29,000 ft. observation altitude). Main lobe at (0, 0) over transmitting antenna, 1 mi NS × 1/2 mi EW 3 dB width. Numbers at lobes indicate relative amplitude. ⊠ is location of minor side lobes, each of which has rel. amp. of 54 or less. X represents even lower power side lobes.

mined from the aircraft's internal navigation system (Figures 2a-2b) deviate a little from the planned trajections. A seventh track, from north to south was added to confirm some of the earlier measurements.

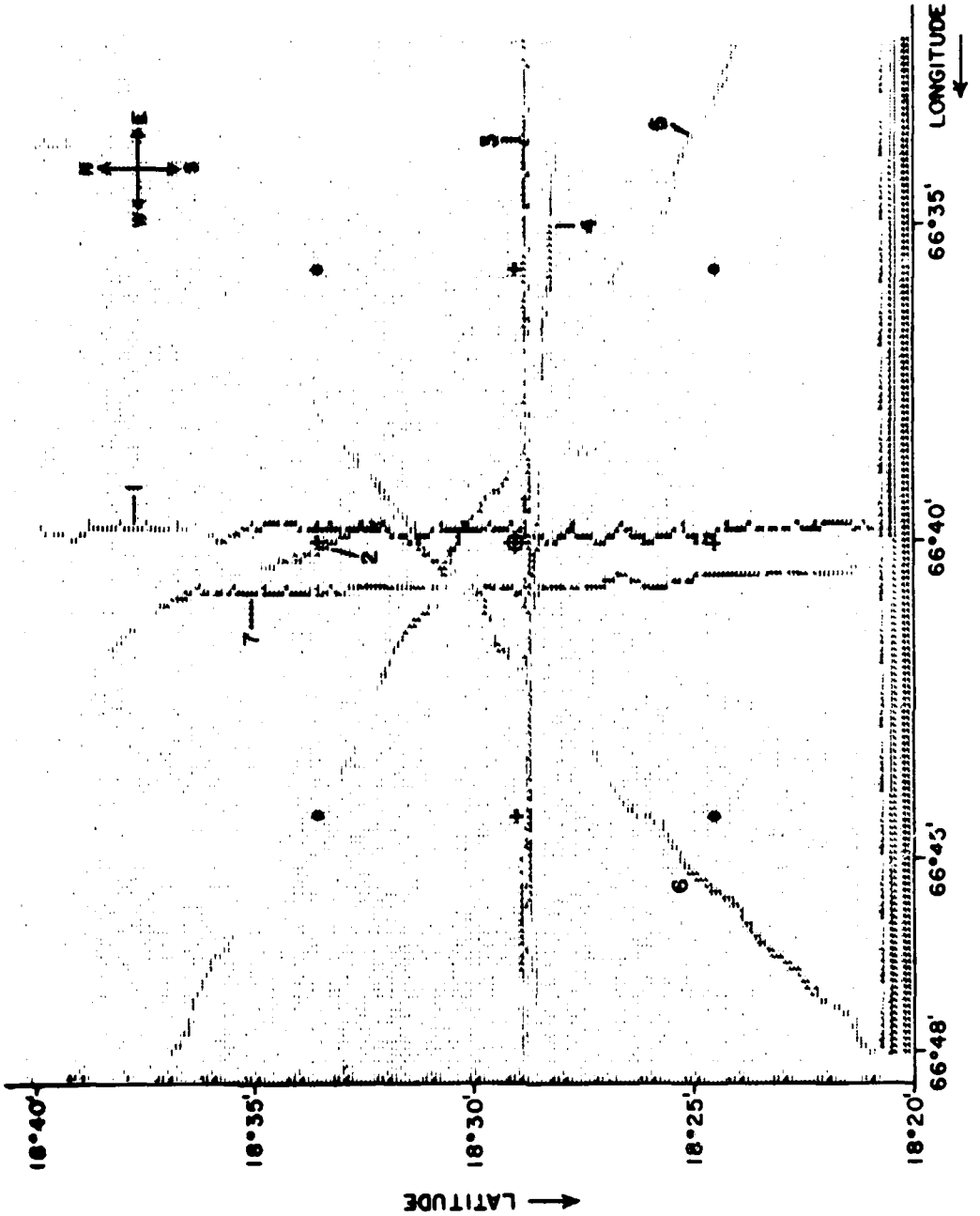
AMPLITUDE VS. AIRCRAFT POSITION FOR SEVEN
FLIGHT TRACKS OVER HEATER ANTENNA
LONGITUDE
66°35'
66°40'
66°45'
66°48'
LATITUDE
18°40'
18°35'
18°30'
18°25'
18°20'
1
2
3
4
5
6
7
N
E
S
W

Figure 2a

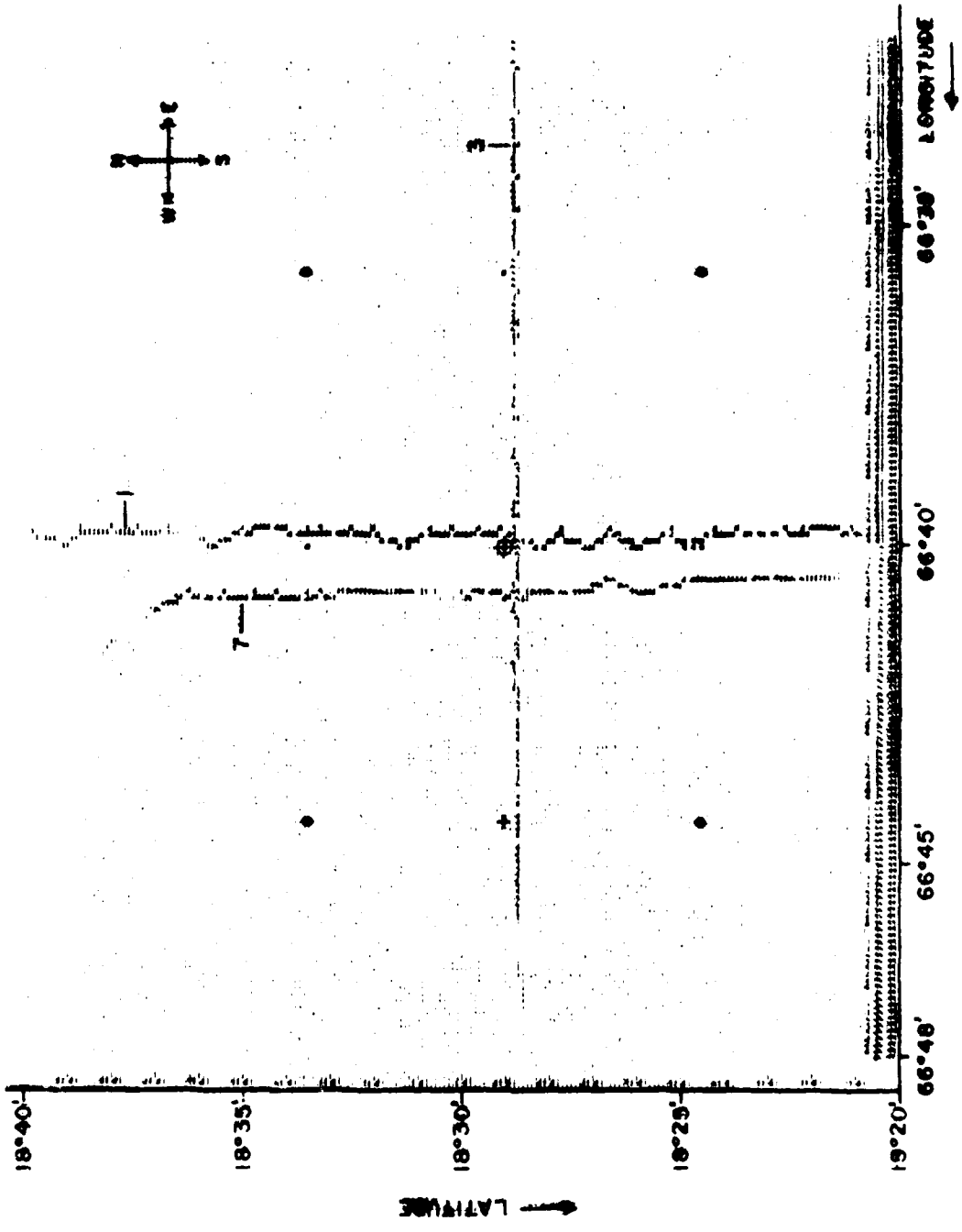
AMPLITUDE VS. AIRCRAFT POSITION
FOR FLIGHT TRACKS 1, 3, AND 7
LONGITUDE
LATITUDE
66°48'
66°45'
66°40'
66°35'
18°40'
18°35'
18°30'
18°25'
19°20'
1
3
7

Figure 2b

3.0 FIELD STRENGTH MEASUREMENTS

The Digisonde was programmed to operate on fixed frequency (5.1 MHz) making one measurement every one-half second during the first track, then every 7/8 second. The received signal was measured with 1.5 dB resolution, recording five binary bits (Bibl and Reinisch, 1978). The data were printed on-line and also recorded on digital magnetic tape. Before these numbers can be used they must be scaled according to calibration measurements performed on the Digisonde. The cross-reference table from these measurements is given in Table 1. In addition the three main amplitude peaks of flight track 1 had to be corrected for saturation. Figures 3 to 9 show the corrected signal amplitudes measured during the seven aircraft passes. This information is also given in Tables 2a-g. To back up the Digisonde measurements, a Collins R390 receiver was also connected to the antenna and chart recordings of the signal variations were made looking much like the plots in Figures 3 to 9.

It must be understood that the recorded amplitudes are proportional to the signal level at the receiver input but not necessarily to the absolute field strength at the aircraft location. The local field strength values are essentially multiplied by the antenna gain of the aircraft 3-wire antenna system. It is known from scale model measurements that the aircraft radiation pattern at 5 MHz is very anisotropic as shown in Figure 10. It is not certain, however, how accurately these scale measurements represent the true aircraft radiation pattern.

Recorded	Actual	Recorded	Actual
0	4	27	24
1	4	28	25
2	5	29	26
3	5	30	27
4	7	31	28
5	8	32	28
6	9	33	29
7	9	34	30
8	10	35	31
9	11	36	32
10	12	37	32
11	13	38	33
12	14	39	34
13	14	40	35
14	15	41	36
15	16	42	38
16	16	43	39
17	17	44	40
18	18	45	41
19	19	46	43
20	19	47	45
21	20	48	46
22	21	49	47
23	22	50	49
24	22	51	50
25	23	52	51
26	23		

Table 1. Cross reference table of recorded level to actual dB level for Digisonde.

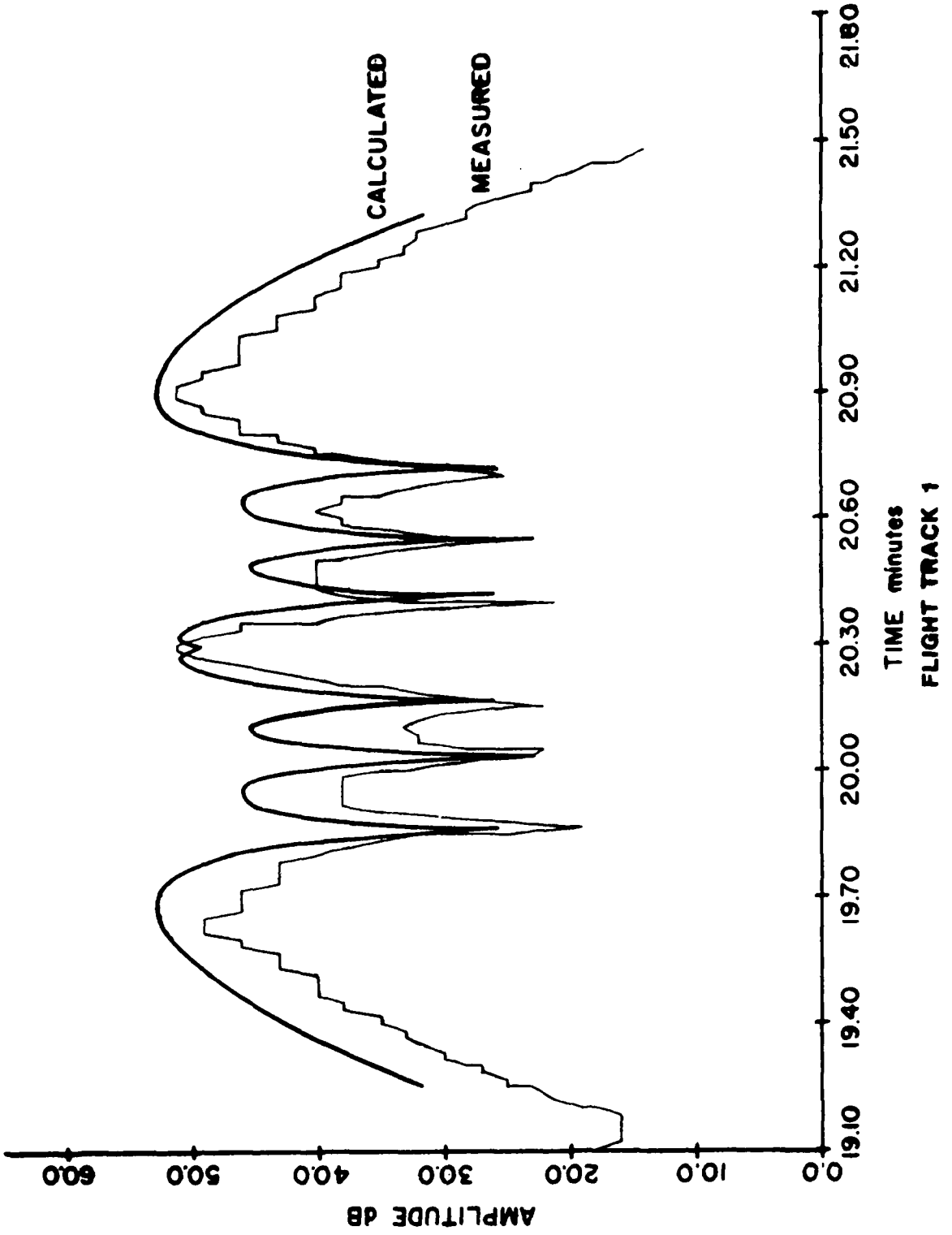

Figure 3. Amplitude vs Universal Time for flight track 1 over heater antenna, includes a theoretical curve for flight track 1. To convert time to aircraft position see Table 2a.

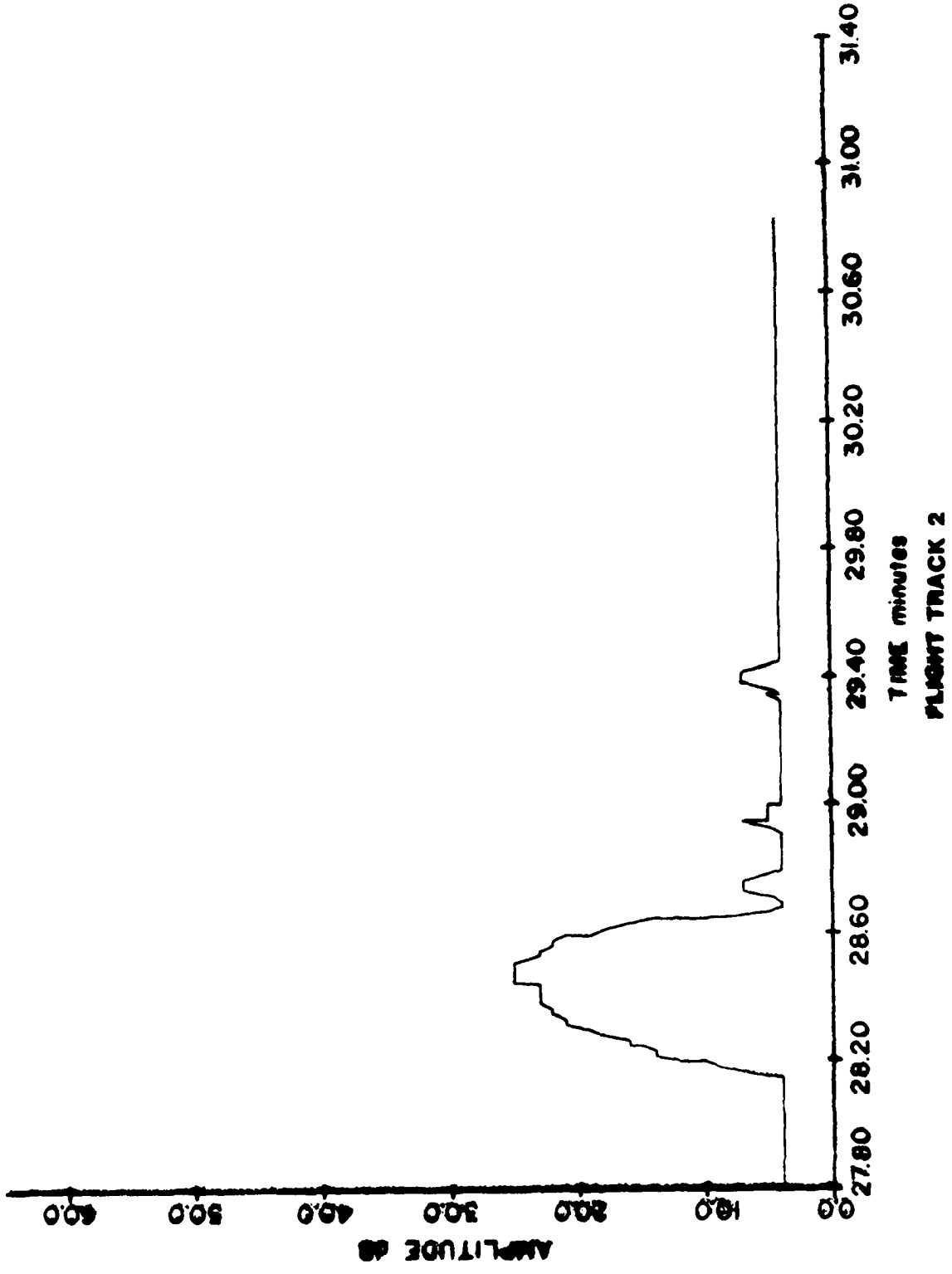

Figure 4. Amplitude vs Universal Time for flight track 2 over heater antenna. To convert time to aircraft position see Table 2b.

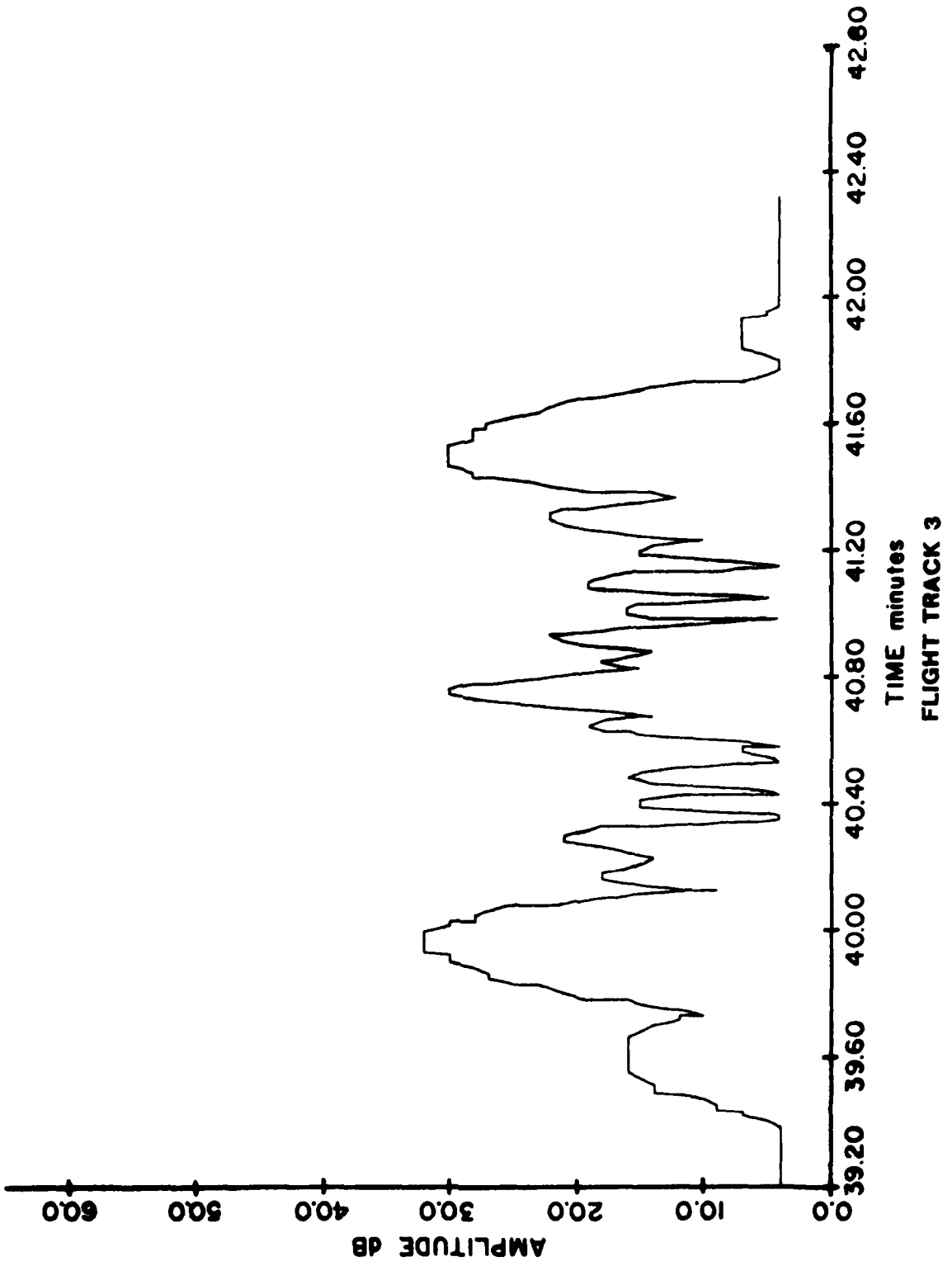

Figure 5. Amplitude vs Universal Time for flight track 3 over heater antenna. To convert time to aircraft position see Table 2c.

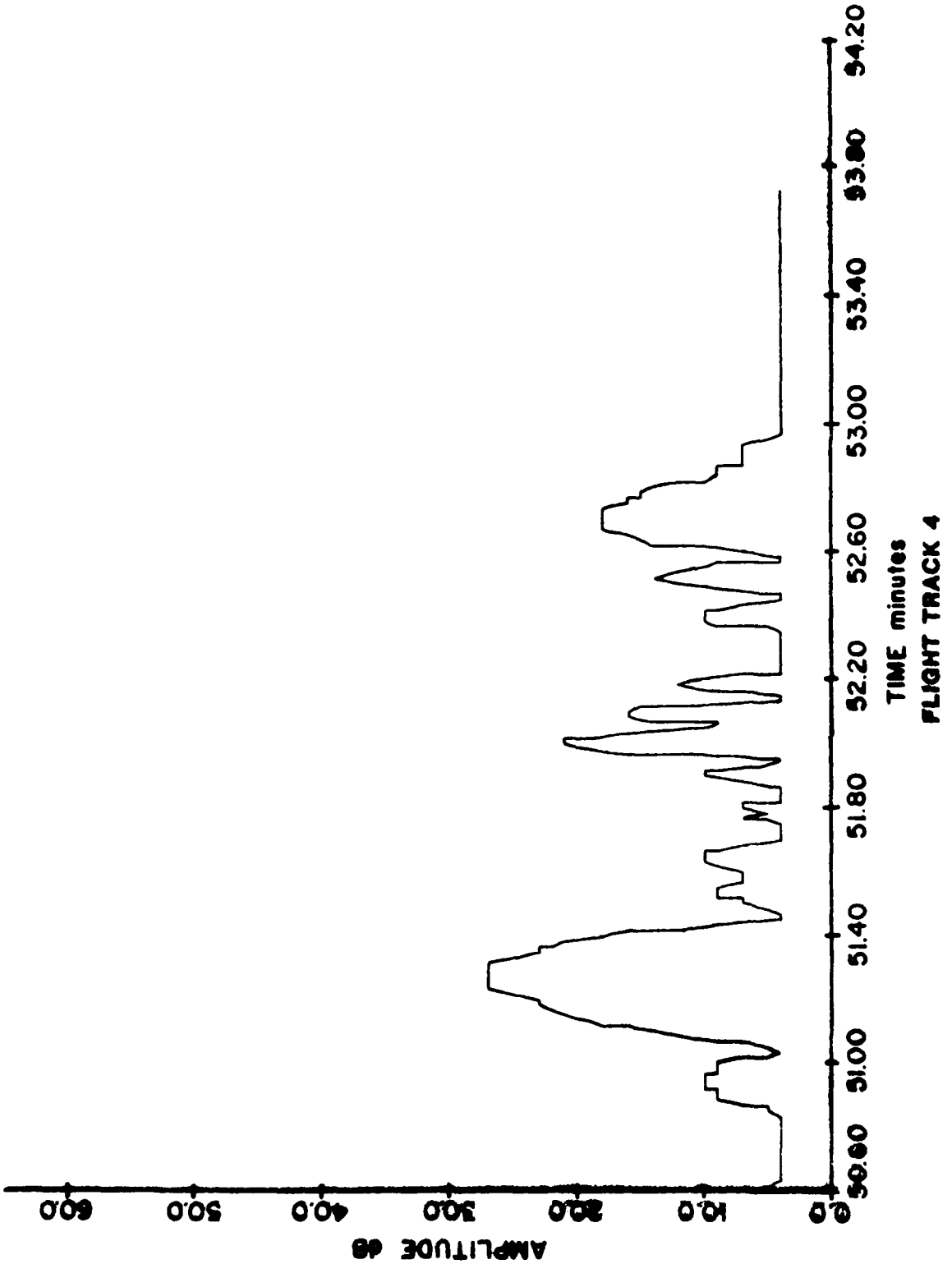

Figure 6. Amplitude vs Universal Time for flight track 4 over heater antenna. To convert time to aircraft position see Table 2d.

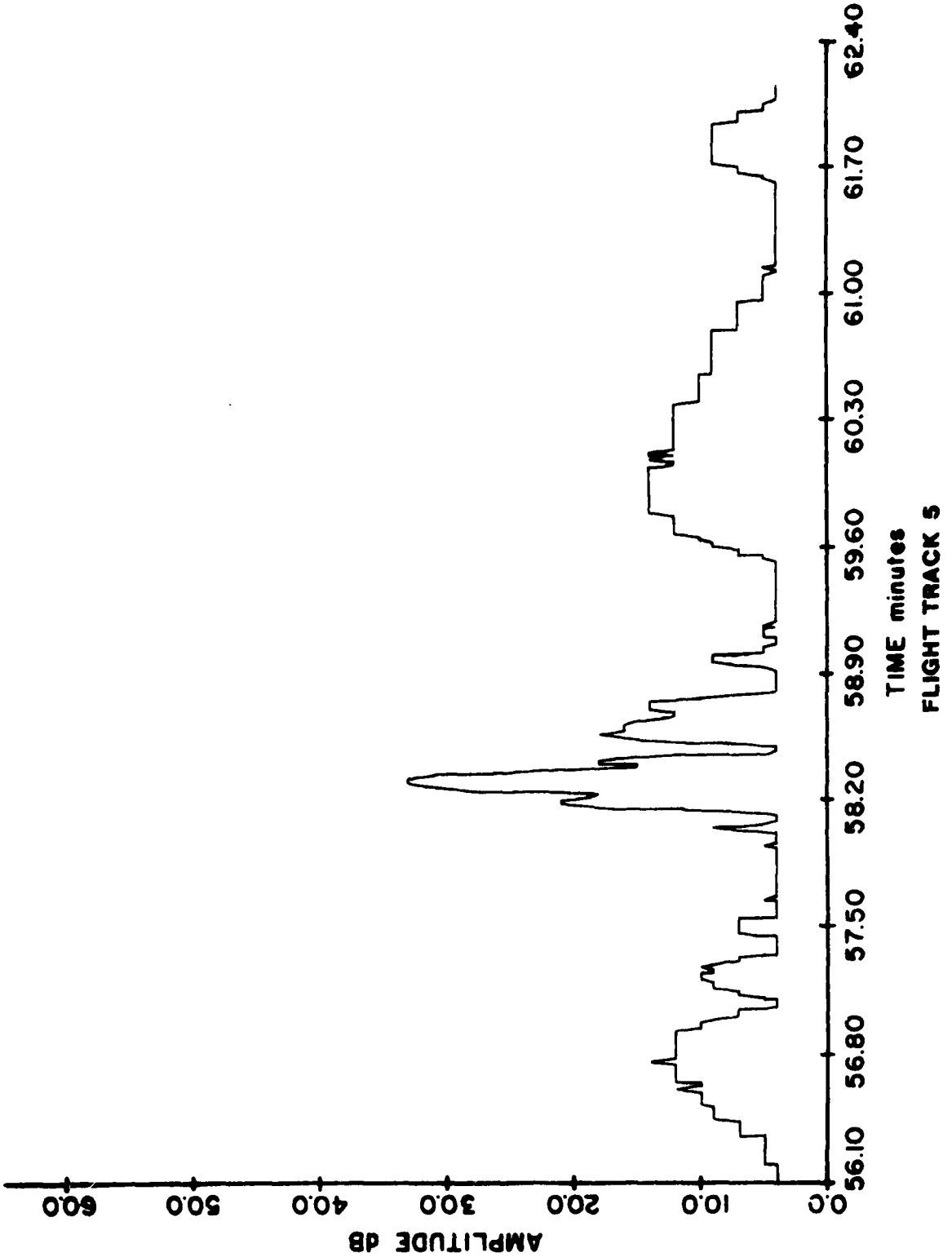

Figure 7. Amplitude vs Universal Time for flight track 5 over heater antenna. To convert time to aircraft position see Table 2e.

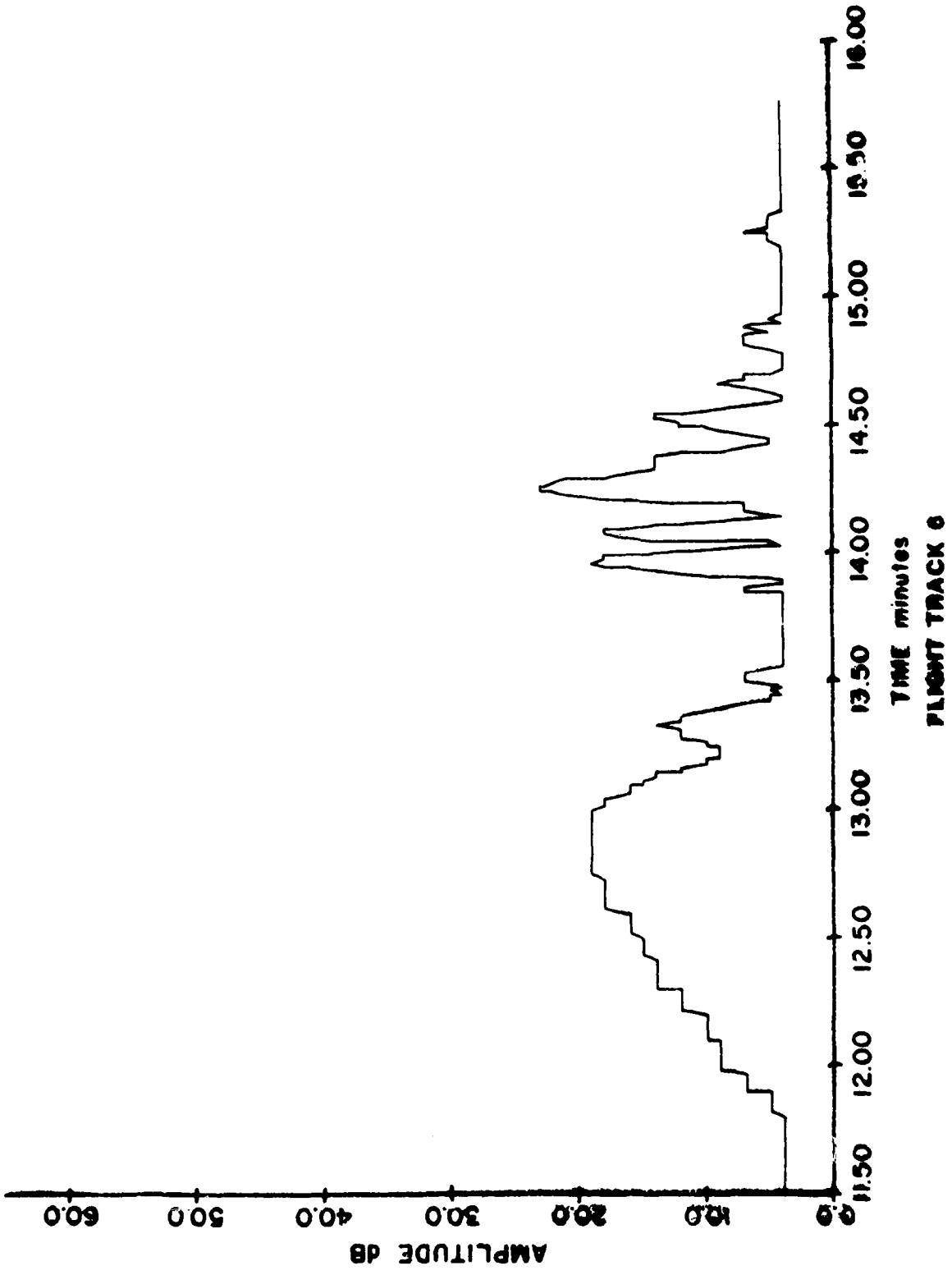

Figure 8. Amplitude vs Universal Time for flight track 6 over heater antenna. To convert time to aircraft position see Table 2f.

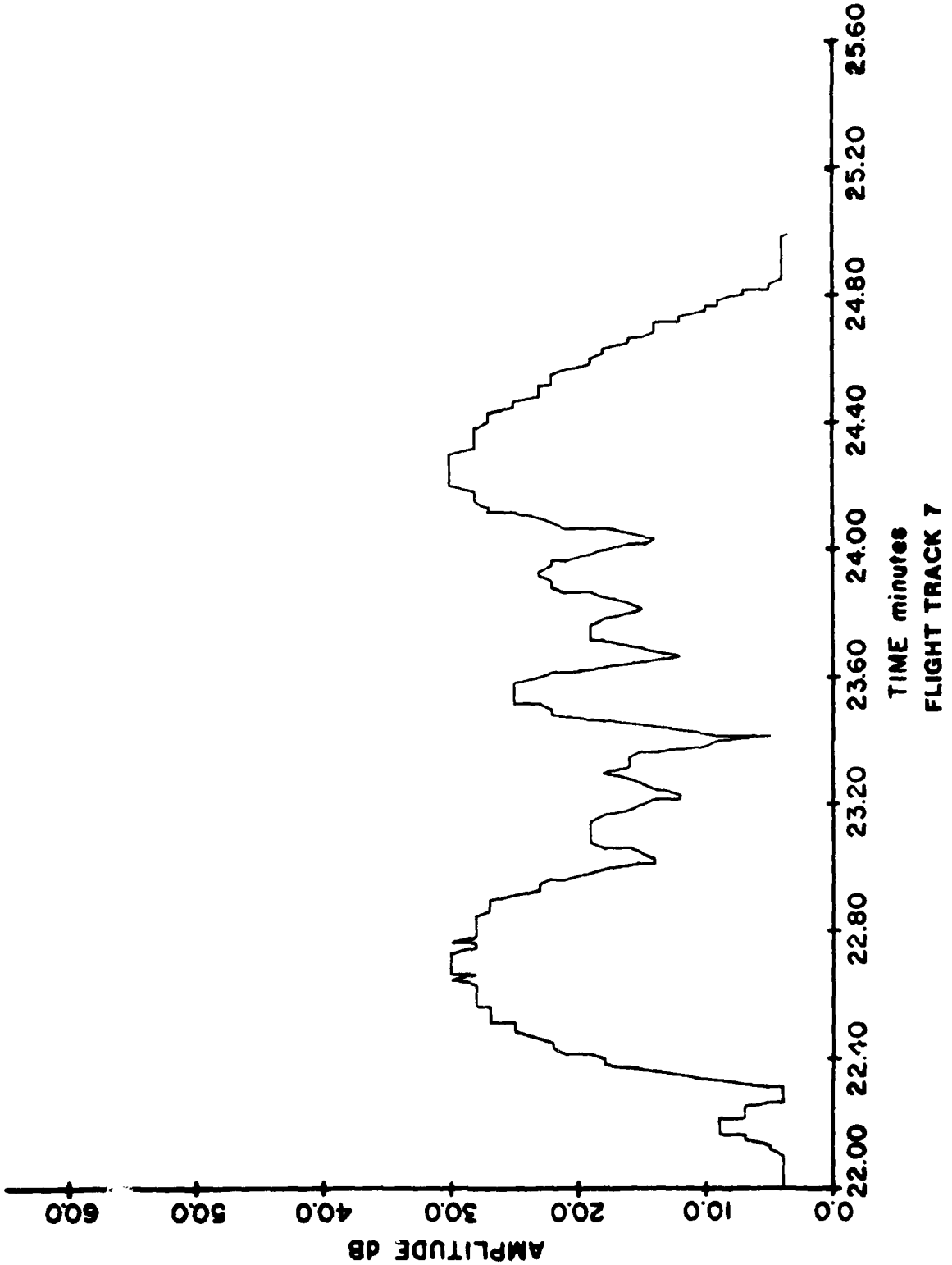

Figure 9. Amplitude vs Universal Time for flight track 7 over heater antenna. To convert time to aircraft position see Table 2g.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
14:17:27	380	95	4	14:17:27	380	95	4	14:17:28	380	96	4	14:17:29	381	97	4
14:17:30	381	98	4	14:17:30	382	98	4	14:17:31	382	99	4	14:17:32	383	100	4
14:17:33	382	101	4	14:17:33	382	101	4	14:17:34	383	102	4	14:17:35	384	103	4
14:17:36	384	104	4	14:17:36	385	105	4	14:17:37	385	106	4	14:17:38	385	106	4
14:17:39	386	107	4	14:17:39	386	108	4	14:17:40	387	108	4	14:17:41	387	109	4
14:17:42	387	109	4	14:17:42	387	110	4	14:17:43	388	110	4	14:17:44	387	111	4
14:17:45	388	112	4	14:17:45	389	112	4	14:17:46	389	113	4	14:17:47	389	113	4
14:17:48	389	114	4	14:17:48	390	114	4	14:17:49	390	115	4	14:17:50	390	116	4
14:17:51	390	117	5	14:17:51	390	119	4	14:17:52	390	120	5	14:17:53	391	121	5
14:17:54	391	122	7	14:17:54	391	124	5	14:17:55	390	125	7	14:17:56	391	126	7
14:17:57	391	126	7	14:17:57	392	127	7	14:17:58	392	128	7	14:17:59	392	129	7
14:18: 0	392	129	7	14:18: 0	393	130	9	14:18: 1	392	131	7	14:18: 2	393	132	9
14:18: 3	393	133	7	14:18: 3	393	134	9	14:18: 4	394	135	9	14:18: 5	394	136	10
14:18: 6	394	136	10	14:18: 6	394	136	10	14:18: 7	394	138	10	14:18: 8	394	139	10
14:18: 9	394	140	12	14:18: 9	394	140	10	14:18:10	394	141	12	14:18:11	394	142	12
14:18:12	394	143	14	14:18:12	394	143	12	14:18:13	394	144	14	14:18:14	395	145	14
14:18:15	395	145	14	14:18:15	395	146	14	14:18:16	396	147	14	14:18:17	395	148	14
14:18:18	396	149	14	14:18:18	396	150	14	14:18:19	396	151	14	14:18:20	396	151	15
14:18:21	396	152	15	14:18:21	396	153	15	14:18:22	396	154	15	14:18:23	395	155	15
14:18:24	396	156	15	14:18:24	396	156	16	14:18:25	396	157	16	14:18:26	396	158	16
14:18:27	396	159	16	14:18:27	396	159	16	14:18:28	396	160	16	14:18:29	395	161	16
14:18:30	396	162	16	14:18:30	396	163	18	14:18:31	396	164	16	14:18:32	396	165	16
14:18:33	396	166	18	14:18:33	396	167	18	14:18:34	395	167	18	14:18:35	396	168	18
14:18:36	396	169	18	14:18:36	398	169	18	14:18:37	396	169	18	14:18:38	397	170	18
14:18:39	397	170	18	14:18:39	397	171	18	14:18:40	397	171	18	14:18:41	397	172	19
14:18:42	397	174	19	14:18:42	396	175	18	14:18:43	396	177	19	14:18:44	396	178	19
14:18:45	395	180	19	14:18:45	395	180	19	14:18:46	396	181	19	14:18:47	396	182	19
14:18:48	396	183	19	14:18:48	396	183	19	14:18:49	396	184	21	14:18:50	396	185	21
14:18:51	395	186	21	14:18:51	395	186	21	14:18:52	396	187	21	14:18:53	396	188	21
14:18:54	396	189	21	14:18:54	397	189	21	14:18:55	397	190	21	14:18:56	397	191	21
14:18:57	397	192	21	14:18:57	397	192	21	14:18:58	397	193	21	14:18:59	397	194	21
14:19: 0	397	195	21	14:19: 0	398	197	21	14:19: 1	398	198	21	14:19: 2	397	198	19
14:19: 3	398	200	19	14:19: 3	398	200	19	14:19: 4	398	201	19	14:19: 5	398	202	18
14:19: 6	398	203	18	14:19: 6	398	203	18	14:19: 7	398	204	16	14:19: 8	397	205	16
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14:19:12	398	209	18	14:19:12	398	210	18	14:19:13	397	211	21	14:19:14	398	212	22
14:19:15	398	212	23	14:19:15	398	213	25	14:19:16	397	214	25	14:19:17	397	215	27
14:19:18	397	215	27	14:19:18	397	216	28	14:19:19	397	217	30	14:19:20	397	218	30
14:19:21	397	218	32	14:19:21	397	219	32	14:19:22	397	220	33	14:19:23	398	221	33
14:19:24	398	221	35	14:19:24	398	222	35	14:19:25	397	222	35	14:19:26	398	223	38
14:19:27	398	224	38	14:19:27	398	224	38	14:19:28	398	225	40	14:19:29	398	225	40
14:19:30	397	226	40	14:19:30	397	226	40	14:19:31	398	228	40	14:19:32	398	229	43
14:19:33	398	231	43	14:19:33	398	232	43	14:19:34	398	234	43	14:19:35	398	235	46
14:19:36	397	237	46	14:19:36	397	237	46	14:19:37	398	238	49	14:19:38	398	239	49
14:19:39	398	240	49	14:19:39	398	241	49	14:19:40	398	242	46	14:19:41	397	242	46
14:19:42	398	244	46	14:19:42	398	244	46	14:19:43	399	245	46	14:19:44	399	245	43
14:19:45	399	246	43	14:19:45	399	247	43	14:19:46	400	247	43	14:19:47	400	247	43
14:19:48	400	248	40	14:19:48	399	248	40	14:19:49	399	250	38	14:19:50	399	250	35
14:19:51	399	251	32	14:19:51	399	252	35	14:19:52	398	252	19	14:19:53	397	252	28
14:19:54	398	254	33	14:19:54	399	255	35	14:19:55	399	256	38	14:19:58	399	257	38

Table 2a. Amplitude in dB vs aircraft coordinates and Universal Time (on flight track) over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 387 is 66°38.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
14:19:57	399	258	38	14:19:57	400	259	38	14:19:58	400	260	38	14:19:59	400	261	38
14:20: 0	399	261	35	14:20: 0	399	262	33	14:20: 1	399	263	30	14:20: 2	399	264	23
14:20: 3	398	264	22	14:20: 3	398	265	28	14:20: 4	397	266	32	14:20: 5	398	267	32
14:20: 6	399	268	33	14:20: 6	399	268	33	14:20: 7	399	269	32	14:20: 8	400	270	30
14:20: 9	400	271	25	14:20: 9	400	271	22	14:20:10	400	272	27	14:20:11	399	273	32
14:20:12	399	274	35	14:20:12	399	275	38	14:20:13	399	276	40	14:20:14	398	277	43
14:20:15	397	277	46	14:20:15	397	277	46	14:20:16	398	278	49	14:20:17	399	279	51
14:20:18	399	279	51	14:20:18	399	280	51	14:20:19	399	280	49	14:20:20	400	281	46
14:20:21	400	281	46	14:20:21	400	281	40	14:20:22	400	283	38	14:20:23	399	284	32
14:20:24	399	286	21	14:20:24	399	288	33	14:20:25	398	289	38	14:20:26	397	291	40
14:20:27	398	292	40	14:20:27	398	292	40	14:20:28	398	293	40	14:20:29	398	293	40
14:20:30	398	294	40	14:20:30	398	295	38	14:20:31	398	295	35	14:20:32	397	296	30
14:20:33	398	297	23	14:20:33	398	298	30	14:20:34	398	299	33	14:20:35	398	299	38
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14:21:12	398	336	35	14:21:12	398	337	35	14:21:13	398	339	35	14:21:14	397	340	33
14:21:15	397	341	33	14:21:15	397	342	33	14:21:16	397	344	32	14:21:17	397	345	32
14:21:18	397	346	30	14:21:18	397	346	30	14:21:19	397	347	28	14:21:20	398	348	28
14:21:21	398	349	27	14:21:21	398	349	27	14:21:22	397	350	25	14:21:23	398	351	23
14:21:24	398	352	23	14:21:24	399	353	22	14:21:25	399	353	21	14:21:26	399	354	19
14:21:27	399	355	18	14:21:27	400	356	16	14:21:28	400	357	15	14:21:29	400	358	14
14:21:30	399	359	12	14:21:30	399	360	9	14:21:31	399	361	5	14:21:32	398	362	4
14:21:33	397	362	4	14:21:33	397	362	4	14:21:34	398	364	4	14:21:35	398	364	4
14:21:36	398	365	7	14:21:36	398	366	7	14:21:37	398	367	9	14:21:38	398	367	10
14:21:39	397	367	10	14:21:39	397	367	12	14:21:40	398	369	12	14:21:41	398	370	14
14:21:42	398	371	14	14:21:42	398	371	14	14:21:43	398	372	14	14:21:44	398	373	14
14:21:45	397	374	15	14:21:45	397	374	15	14:21:46	398	375	15	14:21:47	398	376	15
14:21:48	398	377	15	14:21:48	398	378	15	14:21:49	398	379	15	14:21:50	397	380	15
14:21:51	398	381	15	14:21:51	398	382	15	14:21:52	398	383	15	14:21:53	398	383	15
14:21:54	398	384	15	14:21:54	398	385	15	14:21:55	398	386	15	14:21:56	397	387	15
14:21:57	398	387	15	14:21:57	399	388	15	14:21:58	399	388	15	14:21:59	399	389	15
14:22: 0	399	389	15	14:22: 0	400	390	15	14:22: 1	400	390	15	14:22: 2	400	391	14
14:22: 3	399	393	15	14:22: 3	399	394	14	14:22: 4	399	395	14	14:22: 5	399	397	14
14:22: 6	398	398	14	14:22: 6	398	400	14	14:22: 7	397	400	14	14:22: 8	398	402	14
14:22: 9	398	402	14	14:22: 9	398	403	14	14:22:10	398	404	14	14:22:11	398	405	14
14:22:12	398	405	14	14:22:12	398	406	14	14:22:13	397	407	14	14:22:14	398	408	14
14:22:15	398	409	14	14:22:15	398	410	12	14:22:16	398	411	12	14:22:17	398	412	12
14:22:18	397	412	12	14:22:18	397	412	12	14:22:19	398	414	12	14:22:20	398	415	12
14:22:21	398	416	12	14:22:21	398	417	12	14:22:22	398	418	12	14:22:23	398	419	12
14:22:24	397	420	12	14:22:24	397	420	10								

Table 2a. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 1 over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
14:26:58	424	420	4	14:26:59	423	419	4	14:27: 0	423	419	4	14:27: 0	422	418	4
14:27: 1	422	417	4	14:27: 2	421	417	4	14:27: 3	421	416	4	14:27: 3	420	416	4
14:27: 4	420	415	4	14:27: 5	420	414	4	14:27: 6	419	413	4	14:27: 6	419	411	4
14:27: 7	419	410	4	14:27: 8	418	409	4	14:27: 9	417	407	4	14:27: 9	417	407	4
14:27:10	418	407	4	14:27:11	418	405	4	14:27:12	418	405	4	14:27:12	417	404	4
14:27:13	417	403	4	14:27:14	417	402	4	14:27:15	417	400	4	14:27:15	417	400	4
14:27:16	417	400	4	14:27:17	417	400	4	14:27:18	417	399	4	14:27:18	416	398	4
14:27:19	416	397	4	14:27:20	416	397	4	14:27:21	415	395	4	14:27:21	415	395	4
14:27:22	416	395	4	14:27:23	416	394	4	14:27:24	416	393	4	14:27:24	416	393	4
14:27:25	416	392	4	14:27:26	415	390	4	14:27:27	416	390	4	14:27:27	415	389	4
14:27:28	415	388	4	14:27:29	415	387	4	14:27:30	415	387	4	14:27:30	415	386	4
14:27:31	414	385	4	14:27:32	414	384	4	14:27:33	414	383	4	14:27:33	414	383	4
14:27:34	414	382	4	14:27:35	413	382	4	14:27:36	413	381	4	14:27:36	413	381	4
14:27:37	412	380	4	14:27:38	413	379	4	14:27:39	413	378	4	14:27:39	412	377	4
14:27:40	412	377	4	14:27:41	412	376	4	14:27:42	412	375	4	14:27:45	411	374	4
14:27:45	411	373	4	14:27:46	411	372	4	14:27:47	411	372	4	14:27:48	410	371	4
14:27:48	410	370	4	14:27:49	410	369	4	14:27:50	410	368	4	14:27:51	409	368	4
14:27:51	409	367	4	14:27:52	409	367	4	14:27:53	408	366	4	14:27:54	407	365	4
14:27:54	407	365	4	14:27:55	408	365	4	14:27:56	408	363	4	14:27:57	408	362	4
14:27:57	407	361	4	14:27:58	407	360	4	14:27:59	407	358	4	14:28: 0	407	357	4
14:28: 0	407	357	4	14:28: 1	406	356	4	14:28: 2	406	355	4	14:28: 3	405	355	4
14:28: 3	405	354	4	14:28: 4	405	353	4	14:28: 5	404	352	4	14:28: 6	404	351	4
14:28: 6	404	351	4	14:28: 7	404	350	4	14:28: 8	404	350	4	14:28: 9	404	349	4
14:28: 9	404	348	5	14:28:10	404	348	7	14:28:11	404	347	9	14:28:12	404	346	10
14:28:12	404	345	12	14:28:13	404	345	14	14:28:14	403	344	14	14:28:15	403	343	15
14:28:15	403	342	16	14:28:16	403	342	18	14:28:17	402	340	18	14:28:18	403	340	19
14:28:18	403	340	19	14:28:19	403	339	21	14:28:20	402	338	21	14:28:21	402	337	22
14:28:21	402	337	22	14:28:22	402	335	22	14:28:23	402	335	23	14:28:24	401	335	23
14:28:24	401	334	23	14:28:25	401	334	23	14:28:26	401	333	23	14:28:27	400	333	23
14:28:27	400	332	25	14:28:28	400	332	25	14:28:29	400	331	25	14:28:30	399	330	25
14:28:30	399	329	25	14:28:31	399	328	25	14:28:32	398	327	23	14:28:33	397	325	23
14:28:33	397	325	23	14:28:34	398	326	22	14:28:35	398	324	22	14:28:36	398	323	21
14:28:36	397	323	19	14:28:37	397	322	16	14:28:38	397	321	16	14:28:39	397	320	14
14:28:39	397	320	10	14:28:40	397	320	5	14:28:41	397	319	4	14:28:42	397	319	4
14:28:42	396	319	4	14:28:43	396	319	5	14:28:44	396	318	7	14:28:45	395	317	7
14:28:45	395	317	7	14:28:46	396	316	7	14:28:47	395	315	5	14:28:48	395	313	4
14:28:48	395	311	4	14:28:49	394	310	4	14:28:50	394	307	4	14:28:51	394	307	4
14:28:51	393	306	4	14:28:52	393	305	4	14:28:53	392	304	4	14:28:54	392	304	4
14:28:54	392	303	4	14:28:55	391	302	4	14:28:56	390	301	5	14:28:57	391	301	7
14:28:57	391	300	5	14:28:58	391	300	5	14:28:59	390	299	5	14:29: 0	390	299	5
14:29: 0	390	298	4	14:29: 1	390	297	4	14:29: 2	390	297	4	14:29: 3	390	296	4
14:29: 3	390	296	4	14:29: 4	390	295	4	14:29: 5	389	294	4	14:29: 6	389	293	4
14:29: 6	389	293	4	14:29: 7	389	292	4	14:29: 8	389	291	4	14:29: 9	389	290	4
14:29: 9	389	290	4	14:29:10	388	289	4	14:29:11	388	288	4	14:29:12	388	287	4
14:29:12	388	287	4	14:29:13	387	286	4	14:29:14	388	285	4	14:29:15	388	284	4
14:29:15	387	283	4	14:29:16	387	283	4	14:29:17	387	282	4	14:29:18	387	281	4
14:29:18	387	281	4	14:29:19	387	280	4	14:29:20	387	279	4	14:29:21	387	278	5
14:29:21	386	278	4	14:29:22	386	277	5	14:29:23	385	276	7	14:29:24	385	275	7
14:29:24	385	275	7	14:29:25	386	274	7	14:29:26	386	273	5	14:29:27	386	272	4
14:29:27	386	272	4	14:29:28	385	271	4	14:29:29	385	270	4	14:29:30	386	270	4

Table 2b. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 2 over the heater antenna. LO = Longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = Latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
14:29:30	385	269	4	14:29:31	385	269	4	14:29:32	384	268	4	14:29:33	384	268	4
14:29:33	384	268	4	14:29:34	383	267	4	14:29:35	382	267	4	14:29:36	383	266	4
14:29:36	383	265	4	14:29:37	383	264	4	14:29:38	382	262	4	14:29:39	382	261	4
14:29:39	382	260	4	14:29:40	382	259	4	14:29:41	382	257	4	14:29:42	382	257	4
14:29:42	381	256	4	14:29:43	381	255	4	14:29:44	381	255	4	14:29:45	381	254	4
14:29:45	380	253	4	14:29:46	380	252	4	14:29:47	380	251	4	14:29:48	380	250	4
14:29:48	380	249	4	14:29:49	380	248	4	14:29:50	380	248	4	14:29:51	380	247	4
14:29:51	380	246	4	14:29:52	380	245	4	14:29:53	380	244	4	14:29:54	380	244	4
14:29:54	380	243	4	14:29:55	379	242	4	14:29:56	379	242	4	14:29:57	379	241	4
14:29:57	379	241	4	14:29:58	379	240	4	14:29:59	378	240	4	14:30: 0	378	239	4
14:30: 0	378	238	4	14:30: 1	378	237	4	14:30: 2	377	237	4	14:30: 3	377	236	4
14:30: 3	377	236	4	14:30: 4	377	235	4	14:30: 5	377	234	4	14:30: 6	377	233	4
14:30: 6	377	233	4	14:30: 7	377	232	4	14:30: 8	377	231	4	14:30: 9	377	230	4
14:30: 9	377	230	4	14:30:10	377	229	4	14:30:11	376	229	4	14:30:12	376	228	4
14:30:12	376	227	4	14:30:13	375	227	4	14:30:14	375	226	4	14:30:15	375	225	4
14:30:15	375	224	4	14:30:16	375	223	4	14:30:17	375	222	4	14:30:18	374	222	4
14:30:18	374	221	4	14:30:19	374	220	4	14:30:20	374	2.8	4	14:30:21	374	218	4
14:30:21	373	218	4	14:30:22	373	217	4	14:30:23	372	216	4	14:30:24	372	215	4
14:30:24	371	215	4	14:30:25	370	213	4	14:30:26	371	213	4	14:30:27	371	212	4
14:30:27	371	211	4	14:30:28	371	210	4	14:30:29	371	209	4	14:30:30	371	208	4
14:30:30	371	207	4	14:30:31	370	206	4	14:30:32	371	205	4	14:30:33	371	204	4
14:30:33	371	204	4	14:30:34	370	203	4	14:30:35	370	202	4	14:30:36	370	201	4
14:30:36	370	201	4	14:30:37	370	200	4	14:30:38	370	199	4	14:30:39	370	199	4
14:30:39	370	198	4	14:30:40	369	197	4	14:30:41	369	197	4	14:30:42	369	196	4
14:30:42	369	196	4	14:30:43	369	195	4	14:30:44	369	194	4	14:30:45	369	193	4
14:30:45	368	193	4	14:30:46	368	192	4	14:30:47	368	191	4	14:30:48	367	190	4
14:30:48	367	190	4	14:30:49	368	189	4	14:30:50	368	188	4	14:30:51	367	187	4
14:30:51	367	186	4	14:30:52	367	185	4	14:30:53	367	183	4				

Table 2b. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 2 over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
14:38:49	272	295	4	14:38:50	273	295	4	14:38:50	273	295	4	14:38:51	274	295	4
14:38:52	275	294	4	14:38:53	275	294	4	14:38:53	276	294	4	14:38:54	276	294	4
14:38:55	277	293	4	14:38:56	278	294	4	14:38:56	278	294	4	14:38:57	279	294	4
14:38:58	280	293	4	14:38:59	280	293	4	14:38:59	281	293	4	14:39: 0	281	293	4
14:39: 1	282	292	4	14:39: 2	283	293	4	14:39: 2	284	293	4	14:39: 3	285	293	4
14:39: 4	285	292	4	14:39: 5	286	292	4	14:39: 5	287	292	4	14:39: 6	287	292	4
14:39: 7	289	292	4	14:39: 8	289	291	4	14:39: 8	290	291	4	14:39: 9	291	290	4
14:39:10	292	290	4	14:39:11	292	290	4	14:39:11	293	289	4	14:39:12	293	288	4
14:39:13	295	289	4	14:39:14	296	289	4	14:39:14	296	289	4	14:39:15	297	289	4
14:39:16	298	289	4	14:39:17	298	288	4	14:39:17	298	288	4	14:39:18	300	289	4
14:39:19	301	289	4	14:39:20	302	289	4	14:39:20	302	288	4	14:39:21	303	288	4
14:39:22	304	288	4	14:39:23	305	287	4	14:39:23	305	287	4	14:39:24	306	288	5
14:39:25	307	288	7	14:39:26	308	288	7	14:39:26	308	288	9	14:39:27	309	288	9
14:39:28	310	288	10	14:39:29	311	287	12	14:39:29	311	287	14	14:39:30	311	288	14
14:39:31	312	288	14	14:39:32	312	288	15	14:39:32	313	288	15	14:39:33	313	288	16
14:39:34	313	287	16	14:39:35	315	288	16	14:39:35	317	288	16	14:39:36	318	288	16
14:39:37	319	288	16	14:39:38	321	288	16	14:39:38	322	288	16	14:39:39	324	288	16
14:39:40	325	287	16	14:39:41	326	288	15	14:39:41	327	288	15	14:39:42	328	288	14
14:39:43	329	288	12	14:39:44	330	288	12	14.39:44	331	288	10	14:39:45	332	287	12
14:39:46	333	288	15	14:39:47	333	288	16	14:39:47	334	288	19	14:39:48	335	288	21
14:39:49	336	288	22	14:39:50	336	288	23	14:39:50	337	288	25	14:39:51	337	287	27
14:39:52	338	288	27	14:39:53	339	288	28	14:39:52	339	288	28	14:39:54	340	288	30
14:39:55	340	288	30	14:39:56	341	288	30	14:39:56	341	288	32	14:39:57	342	287	32
14:39:58	343	288	32	14:39:59	344	289	32	14:39:59	345	288	32	14:40: 0	346	288	32
14:40: 1	347	288	30	14:40: 2	347	287	30	14:40: 2	347	287	28	14:40: 3	349	288	28
14:40: 4	350	288	27	14:40: 5	351	288	25	14:40: 5	351	288	22	14:40: 6	352	288	19
14:40: 7	353	288	15	14:40: 8	354	287	9	14:40: 8	354	287	12	14:40: 9	355	288	16
14:40:10	356	288	18	14:40:11	357	288	18	14:40:11	358	288	18	14:40:12	359	288	16
14:40:13	360	287	15	14:40:14	361	288	14	14:40:14	361	288	14	14:40:15	362	288	16
14:40:16	363	288	18	14:40:17	364	288	21	14:40:17	364	289	21	14:40:18	365	288	21
14:40:19	365	287	19	14:40:20	366	288	19	14:40:20	366	288	14	14:40:21	367	288	4
14:40:22	367	288	4	14:40:23	367	287	12	14:40:23	367	288	15	14:40:24	368	288	15
14:40:25	367	287	15	14:40:26	370	288	10	14:40:26	371	288	4	14:40:27	373	288	7
14:40:28	375	288	14	14:40:29	377	288	15	14:40:29	378	288	16	14:40:30	380	287	15
14:40:31	380	288	12	14:40:32	381	288	5	14:40.32	381	288	4	14:40:33	382	288	5
14:40:34	382	288	7	14:40:35	383	288	7	14:40:35	383	288	4	14:40:36	384	287	7
14:40:37	385	288	14	14:40:38	386	288	16	14:40.38	387	287	18	14:40:39	388	287	19
14:40:40	385	287	18	14:40:41	390	287	14	14:40:41	390	287	14	14:40:42	391	287	19
14:40:43	392	287	23	14:40:44	393	287	27	14:40:44	393	288	28	14:40:45	394	288	30
14:40.46	395	288	30	14:40:47	395	287	28	14:40:47	395	287	27	14:40:48	397	288	23
14:40:49	398	288	19	14:40:50	399	288	15	14:40:50	399	287	16	14:40:51	400	287	18
14:40:52	401	287	16	14:40:53	402	287	14	14:40:53	402	287	15	14:40:54	403	287	19
14:40:55	404	287	21	14:40:56	405	287	22	14:40:56	406	288	21	14:40:57	407	288	18
14:40:58	407	287	12	14:40:59	408	288	4	14:40:59	409	288	14	14:41: 0	410	288	16
14:41: 1	411	287	16	14:41: 2	412	287	15	14:41: 2	412	287	12	14:41: 3	413	287	5
14:41: 4	414	287	14	14:41: 5	416	287	18	14:41: 5	416	287	19	14:41: 6	417	287	19
14:41: 7	418	288	19	14:41: 8	419	288	15	14:41: 8	420	288	9	14:41: 9	420	287	4
14:41:10	421	288	9	14:41:11	422	288	14	14:41:11	422	288	15	14:41:12	422	287	15
14:41:13	423	287	14	14:41:14	423	288	10	14:41:14	424	287	12	14:41:15	424	287	16
14:41:16	425	287	19	14:41:17	427	287	1	14:41:17	426	287	22	14:41:18	429	287	22

Table 2c. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 2 over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
14:41:19	430	287	22	14:41:20	432	287	21	14:41:20	433	287	19	14:41:21	434	287	16
14:41:22	435	287	12	14:41:23	436	287	14	14:41:23	437	287	18	14:41:24	439	287	22
14:41:25	440	287	23	14:41:26	440	287	27	14:41:26	440	287	28	14:41:27	442	287	28
14:41:28	442	287	30	14:41:29	443	287	30	14:41:29	444	287	30	14:41:30	445	287	30
14:41:31	445	287	30	14:41:32	445	287	30	14:41:32	445	287	30	14:41:33	447	287	28
14:41:34	448	287	28	14:41:35	449	287	28	14:41:35	450	287	27	14:41:36	451	287	27
14:41:37	452	287	25	14:41:38	453	287	23	14:41:38	453	287	23	14:41:39	454	287	22
14:41:40	455	287	21	14:41:41	455	287	19	14:41:41	456	287	18	14:41:42	456	287	15
14:41:43	457	287	14	14:41:44	458	287	10	14:41:44	459	287	7	14:41:45	460	287	5
14:41:46	460	287	4	14:41:47	461	287	4	14:41:47	462	287	4	14:41:48	463	287	4
14:41:49	464	287	5	14:41:50	465	287	7	14:41:50	466	287	7	14:41:51	467	287	7
14:41:52	467	286	7	14:41:53	468	286	7	14:41:53	469	286	7	14:41:54	470	286	7
14:41:55	471	286	7	14:41:56	472	286	7	14:41:56	473	286	5	14:41:57	473	286	5
14:41:58	474	287	4	14:41:59	475	287	4	14:41:59	476	287	4	14:42: 0	477	287	4
14:42: 1	477	287	4	14:42: 2	478	287	4	14:42: 2	478	287	4	14:42: 3	479	287	4
14:42: 4	479	287	4	14:42: 5	480	287	4	14:42: 5	480	287	4	14:42: 6	482	287	4
14:42: 7	483	287	4	14:42: 8	485	287	4	14:42: 8	486	286	4	14:42: 9	488	286	4
14:42:10	489	286	4	14:42:11	490	286	4	14:42:11	490	286	4	14:42:12	492	286	4
14:42:13	493	286	4	14:42:14	494	286	4	14:42:14	494	286	4	14:42:15	495	286	4
14:42:16	496	286	4	14:42:17	497	286	4	14:42:17	497	286	4	14:42:18	498	286	4
14:42:19	499	286	4	14:42:20	500	286	4	14:42:20	502	286	4	14:42:21	503	286	4
14:42:22	504	286	4	14:42:23	505	286	4	14:42:23	505	286	4	14:42:24	506	286	4
14:42:25	507	286	4	14:42:26	507	286	4	14:42:26	508	286	4	14:42:27	508	286	4
14:42:28	509	286	4	14:42:29	510	286	4	14:42:29	511	286	4	14:42:30	512	286	4
14:42:31	5.3	286	4	14:42:32	514	286	4	14:42:32	515	286	4	14:42:33	515	286	4
14:42:34	517	286	4	14:42:35	517	286	4	14:42:35	518	286	4	14:42:36	518	286	4
14:42:37	519	286	4	14:42:38	520	286	4	14:42:38	520	286	4	14:42:39	520	286	4
14:42:40	522	286	4	14:42:41	522	286	4	14:42:41	523	286	4	14:42:42	523	286	4
14:42:43	524	286	4	14:42:44	525	286	4	14:42:44	525	286	4	14:42:45	525	286	4

Table 2c. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 3 over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
14:49:56	547	293	4	14:49:57	547	294	4	14:49:58	546	294	4	14:49:58	545	293	4
14:49:59	545	293	4	14:50: 0	544	293	4	14:50: 1	542	292	4	14:50: 1	542	292	4
14:50: 2	542	293	4	14:50: 3	541	293	4	14:50: 4	540	293	4	14:50: 4	540	293	4
14:50: 5	539	293	4	14:50: 6	538	293	4	14:50: 7	537	292	4	14:50: 7	537	292	4
14:50: 8	536	293	4	14:50: 9	535	293	4	14:50:10	534	293	4	14:50:10	533	292	4
14:50:11	532	292	4	14:50:12	531	292	4	14:50:13	530	292	4	14:50:13	530	292	4
14:50:14	529	292	4	14:50:15	528	292	4	14:50:16	526	292	4	14:50:16	525	292	5
14:50:17	524	292	5	14:50:18	522	292	5	14:50:19	522	292	5	14:50:19	521	292	5
14:50:20	521	292	5	14:50:21	520	292	5	14:50:22	519	292	7	14:50:22	518	292	7
14:50:23	518	292	7	14:50:24	517	292	7	14:50:25	516	292	7	14:50:25	516	292	7
14:50:26	515	292	7	14:50:27	515	292	7	14:50:28	514	292	7	14:50:28	514	292	7
14:50:29	512	292	7	14:50:30	512	292	7	14:50:31	510	292	7	14:50:31	509	292	7
14:50:32	507	292	5	14:50:33	506	292	5	14:50:34	505	292	5	14:50:34	503	292	5
14:50:35	502	292	5	14:50:36	501	292	5	14:50:37	500	292	5	14:50:37	500	292	5
14:50:38	499	291	4	14:50:39	498	291	4	14:50:40	497	291	4	14:50:40	497	291	4
14:50:41	495	291	4	14:50:42	495	291	4	14:50:43	494	291	4	14:50:43	492	291	4
14:50:44	491	291	4	14:50:45	490	291	4	14:50:46	489	291	4	14:50:46	489	291	4
14:50:47	488	291	4	14:50:48	487	290	4	14:50:49	486	290	4	14:50:49	486	290	4
14:50:50	485	290	4	14:50:51	484	289	5	14:50:52	482	288	5	14:50:52	482	288	7
14:50:53	482	289	9	14:50:54	481	289	9	14:50:55	480	289	9	14:50:55	479	289	10
14:50:56	478	289	10	14:50:57	477	288	10	14:50:58	476	289	10	14:50:58	475	289	9
14:50:59	475	289	9	14:51: 0	474	289	9	14:51: 1	473	289	7	14:51: 1	472	289	5
14:51: 2	472	289	4	14:51: 3	470	288	5	14:51: 4	470	289	7	14:51: 4	469	289	9
14:51: 5	468	289	12	14:51: 6	467	289	14	14:51: 7	467	289	16	14:51: 7	466	289	18
14:51: 8	465	289	19	14:51: 9	464	288	21	14:51:10	463	289	22	14:51:10	462	289	22
14:51:11	461	289	23	14:51:12	460	289	23	14:51:13	459	289	25	14:51:13	458	289	25
14:51:14	457	288	27	14:51:15	457	289	27	14:51:16	456	289	27	14:51:16	456	289	27
14:51:17	455	289	27	14:51:18	455	289	27	14:51:19	455	289	27	14:51:19	454	289	27
14:51:20	454	288	25	14:51:21	452	289	23	14:51:22	450	289	23	14:51:22	448	288	22
14:51:23	447	288	21	14:51:24	445	288	18	14:51:25	442	287	16	14:51:25	442	287	12
14:51:26	442	288	9	14:51:27	441	288	4	14:51:28	440	288	4	14:51:28	440	288	4
14:51:29	439	288	5	14:51:30	438	288	7	14:51:31	437	287	7	14:51:31	437	287	9
14:51:32	436	288	9	14:51:33	435	288	9	14:51:34	434	288	7	14:51:34	433	287	7
14:51:35	432	287	7	14:51:36	431	287	7	14:51:37	430	287	9	14:51:37	430	287	9
14:51:38	429	287	10	14:51:39	428	287	10	14:51:40	427	287	10	14:51:40	426	287	9
14:51:41	425	287	7	14:51:42	424	287	4	14:51:43	423	287	4	14:51:43	422	287	4
14:51:44	422	287	4	14:51:45	421	287	4	14:51:46	420	287	5	14:51:46	419	287	7
14:51:47	419	287	5	14:51:48	417	287	7	14:51:49	417	287	7	14:51:49	416	287	4
14:51:50	415	287	4	14:51:51	414	286	4	14:51:52	413	286	4	14:51:52	412	286	5
14:51:53	410	286	7	14:51:54	410	286	10	14:51:55	409	286	10	14:51:55	408	286	9
14:51:56	407	286	5	14:51:57	407	286	4	14:51:58	406	286	10	14:51:58	405	286	16
14:51:59	404	286	19	14:52: 0	403	286	21	14:52: 1	402	286	21	14:52: 1	402	286	19
14:52: 2	401	285	16	14:52: 3	400	285	10	14:52: 4	399	285	9	14:52: 4	399	285	14
14:52: 5	397	285	16	14:52: 6	397	285	16	14:52: 7	397	285	15	14:52: 7	396	285	12
14:52: 8	395	285	4	14:52: 9	395	285	4	14:52:10	394	285	9	14:52:10	394	285	10
14:52:11	392	285	12	14:52:12	391	285	10	14:52:13	389	285	7	14:52:13	388	284	4
14:52:14	386	284	4	14:52:15	385	284	4	14:52:16	382	283	4	14:52:16	382	283	4
14:52:17	382	284	4	14:52:18	381	284	4	14:52:19	379	284	4	14:52:19	378	284	4
14:52:20	377	284	4	14:52:21	375	283	4	14:52:22	375	284	5	14:52:22	374	284	9
14:52:23	374	284	10	14:52:24	373	284	10	14:52:25	372	284	10	14:52:25	371	284	9

Table 2d. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 4 over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
14:52:26	371	284	7	14:52:27	370	283	4	14:52:28	369	284	4	14:52:28	368	284	5
14:52:29	368	284	9	14:52:30	367	284	12	14:52:31	366	284	14	14:52:31	365	284	14
14:52:32	365	284	12	14:52:33	364	283	10	14:52:34	363	284	9	14:52:34	363	283	4
14:52:35	362	283	4	14:52:36	361	283	7	14:52:37	360	283	10	14:52:37	360	282	14
14:52:38	359	282	15	14:52:39	358	282	16	14:52:40	357	282	18	14:52:40	356	282	18
14:52:41	355	282	18	14:52:42	355	282	18	14:52:'	354	282	18	14:52:43	353	282	18
14:52:44	352	282	18	14:52:45	351	282	16	14:52:46	350	282	16	14:52:46	348	282	15
14:52:47	347	282	15	14:52:48	346	282	14	14:52:49	345	282	12	14:52:49	345	282	10
14:52:50	344	282	9	14:52:51	343	282	9	14:52:52	342	282	9	14:52:52	341	281	7
14:52:53	340	281	7	14:52:54	339	281	7	14:52:55	337	281	7	14:52:55	337	281	7
14:52:56	337	281	7	14:52:57	337	281	5	14:52:58	336	281	4	14:52:58	336	282	4
14:52:59	335	282	4	14:53: 0	335	282	4	14:53: 1	334	282	4	14:53: 1	334	282	4
14:53: 2	332	282	4	14:53: 3	331	282	4	14:53: 4	330	282	4	14:53: 4	328	282	4
14:53: 5	326	282	4	14:53: 6	325	282	4	14:53: 7	324	282	4	14:53: 7	323	282	4
14:53: 8	322	282	4	14:53: 9	320	282	4	14:53:10	319	282	4	14:53:10	318	282	4
14:53:11	317	282	4	14:53:12	316	282	4	14:53:13	315	282	4	14:53:13	315	283	4
14:53:14	314	283	4	14:53:15	314	283	4	14:53:16	313	283	4	14:53:16	313	284	4
14:53:17	312	283	4	14:53:18	311	284	4	14:53:19	310	283	4	14:53:19	309	283	4
14:53:20	308	283	4	14:53:21	308	283	4	14:53:22	307	282	4	14:53:22	306	282	4
14:53:23	305	282	4	14:53:24	304	282	4	14:53:25	303	282	4	14:53:25	302	283	4
14:53:26	301	283	4	14:53:27	301	283	4	14:53:28	300	283	4	14:53:28	299	284	4
14:53:29	297	283	4	14:53:30	297	284	4	14:53:31	296	284	4	14:53:31	295	284	4
14:53:32	294	284	4	14:53:33	293	284	4	14:53:34	292	283	4	14:53:34	292	283	4
14:53:35	291	284	4	14:53:36	290	284	4	14:53:37	289	284	4	14:53:37	288	284	4
14:53:38	287	284	4	14:53:39	286	284	4	14:53:40	285	283	4	14:53:40	285	283	4
14:53:41	284	284	4	14:53:42	283	284	4	14:53:43	282	284	4	14:53:43	281	284	4
14:53:44	280	284	4	14:53:45	278	283	4	14:53:46	278	284	4	14:53:46	278	284	4
14:53:47	277	284	4	14:53:48	276	284	4	14:53:49	276	284	4	14:53:49	275	284	4
14:53:50	275	284	4	14:53:51	273	283	4								

Table 2d. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 4 over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
14:55:54	267	212	4	14:55:54	267	212	4	14:55:55	268	213	4	14:55:56	268	213	4
14:55:57	269	214	4	14:55:57	270	214	4	14:55:58	271	215	4	14:55:59	271	215	4
14:56: 0	272	216	4	14:56: 0	272	216	4	14:56: 1	273	216	4	14:56: 2	274	217	4
14:56: 3	274	217	4	14:56: 3	275	217	4	14:56: 4	276	218	4	14:56: 5	277	217	4
14:56: 6	277	218	4	14:56: 6	278	218	4	14:56: 7	278	219	4	14:56: 8	279	219	4
14:56: 9	279	219	4	14:56: 9	280	219	4	14:56:10	280	220	4	14:56:11	281	220	4
14:56:12	282	220	4	14:56:12	283	221	5	14:56:13	284	221	5	14:56:14	284	222	5
14:56:15	285	222	5	14:56:15	286	223	5	14:56:16	287	223	5	14:56:17	287	223	5
14:56:18	288	224	5	14:56:18	289	225	5	14:56:19	289	225	5	14:56:20	290	225	5
14:56:21	290	225	5	14:56:21	291	226	7	14:56:22	291	226	7	14:56:23	292	226	7
14:56:24	293	227	7	14:56:24	294	227	7	14:56:25	295	227	7	14:56:26	296	228	7
14:56:27	297	228	9	14:56:27	298	229	9	14:56:28	298	228	9	14:56:29	300	230	9
14:56:30	301	230	9	14:56:30	302	231	9	14:56:31	303	232	9	14:56:32	304	232	10
14:56:33	305	232	10	14:56:33	305	232	10	14:56:34	306	233	10	14:56:35	307	233	10
14:56:36	308	233	10	14:56:36	308	234	10	14:56:37	309	234	12	14:56:38	310	234	10
14:56:39	311	233	10	14:56:39	311	233	12	14:56:40	312	235	12	14:56:41	312	235	12
14:56:42	313	236	12	14:56:42	313	236	12	14:56:43	314	237	12	14:56:44	314	237	12
14:56:45	315	237	12	14:56:45	315	237	12	14:56:46	316	238	14	14:56:47	317	239	12
14:56:48	318	239	12	14:56:48	319	239	12	14:56:49	320	240	12	14:56:50	320	240	12
14:56:51	322	240	12	14:56:51	322	241	12	14:56:52	323	241	12	14:56:53	324	241	12
14:56:54	325	242	12	14:56:54	325	242	12	14:56:55	326	243	12	14:56:56	327	242	12
14:56:57	328	243	10	14:56:57	328	244	10	14:56:58	329	244	10	14:56:59	330	245	10
14:57: 0	331	245	9	14:57: 0	331	246	9	14:57: 1	332	246	7	14:57: 2	332	246	7
14:57: 3	333	247	7	14:57: 3	333	247	5	14:57: 4	334	248	4	14:57: 5	334	248	4
14:57: 6	335	249	4	14:57: 6	335	249	5	14:57: 7	335	250	5	14:57: 8	336	250	7
14:57: 9	337	251	7	14:57: 9	337	251	7	14:57:10	337	251	9	14:57:11	338	252	9
14:57:12	338	252	9	14:57:12	339	253	9	14:57:13	339	252	10	14:57:14	340	253	10
14:57:15	342	254	10	14:57:15	343	254	9	14:57:16	344	254	9	14:57:17	346	255	10
14:57:18	347	255	9	14:57:18	347	255	9	14:57:19	348	256	7	14:57:20	348	257	7
14:57:21	349	258	5	14:57:21	350	260	4	14:57:22	351	261	4	14:57:23	351	262	4
14:57:24	352	262	4	14:57:24	352	262	4	14:57:25	353	264	4	14:57:26	354	264	4
14:57:27	354	265	4	14:57:27	355	263	5	14:57:28	356	266	7	14:57:29	357	267	7
14:57:30	357	267	7	14:57:30	358	268	7	14:57:31	358	268	7	14:57:32	359	268	7
14:57:33	359	269	7	14:57:33	360	269	4	14:57:34	360	270	4	14:57:35	360	270	4
14:57:36	362	271	4	14:57:36	362	271	4	14:57:37	363	272	4	14:57:38	363	272	4
14:57:39	364	273	4	14:57:39	365	274	5	14:57:40	365	274	4	14:57:41	365	275	4
14:57:42	367	276	4	14:57:42	367	276	4	14:57:43	368	277	4	14:57:44	368	277	4
14:57:45	369	278	4	14:57:45	369	278	4	14:57:46	370	278	4	14:57:47	370	279	4
14:57:48	371	279	4	14:57:48	371	280	4	14:57:49	372	280	4	14:57:50	372	280	4
14:57:51	373	280	4	14:57:51	373	281	4	14:57:52	374	281	4	14:57:53	375	282	4
14:57:54	376	283	4	14:57:54	377	283	4	14:57:55	378	284	4	14:57:56	379	285	4
14:57:57	380	286	5	14:57:57	380	286	5	14:57:58	380	286	4	14:57:59	381	287	4
14:58: 0	381	287	4	14:58: 0	381	288	4	14:58: 1	381	288	4	14:58: 2	382	289	7
14:58: 3	382	288	9	14:58: 3	382	288	7	14:58: 4	383	289	5	14:58: 5	384	290	4
14:58: 6	385	290	4	14:58: 6	387	291	4	14:58: 7	388	291	4	14:58: 8	389	292	7
14:58: 9	390	292	12	14:58: 9	390	292	16	14:58:10	391	293	19	14:58:11	392	294	21
14:58:12	392	295	21	14:58:12	393	297	21	14:58:13	394	298	19	14:58:14	395	298	18
14:58:15	396	300	22	14:58:15	396	300	27	14:58:16	397	301	30	14:58:17	397	301	32
14:58:18	398	302	33	14:58:18	399	303	33	14:58:19	399	303	33	14:58:20	400	303	32
14:58:21	401	304	30	14:58:21	401	305	27	14:58:22	402	305	22	14:58:23	402	305	15

Table 2e. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 5 over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
14:58:24	403	305	15	14:58:24	403	306	18	14:58:25	404	306	18	14:58:26	405	306	16
14:58:27	405	307	12	14:58:27	406	307	5	14:58:28	407	307	4	14:58:29	408	308	4
14:58:30	408	308	4	14:58:30	409	309	4	14:58:31	410	308	10	14:58:32	410	310	15
14:58:33	411	310	16	14:58:33	411	311	16	14:58:34	412	312	18	14:58:35	412	313	16
14:58:36	413	313	16	14:58:36	413	314	16	14:58:37	414	315	16	14:58:38	415	316	15
14:58:39	415	316	14	14:58:39	416	317	14	14:58:40	417	318	12	14:58:41	417	318	12
14:58:42	417	318	14	14:58:42	417	318	14	14:58:43	419	319	14	14:58:44	420	320	14
14:58:45	421	320	14	14:58:45	421	321	12	14:58:46	422	321	9	14:58:47	423	322	7
14:58:48	424	322	4	14:58:48	424	322	4	14:58:49	425	323	4	14:58:50	425	323	4
14:58:51	425	324	4	14:58:51	426	325	4	14:58:52	426	325	4	14:58:53	427	325	4
14:58:54	428	326	4	14:58:54	429	326	4	14:58:55	430	327	4	14:58:56	431	327	5
14:58:57	432	327	7	14:58:57	433	327	7	14:58:58	434	328	9	14:58:59	435	327	9
14:59: 0	435	329	9	14:59: 0	436	330	7	14:59: 1	436	331	5	14:59: 2	436	331	5
14:59: 3	437	332	5	14:59: 3	437	333	5	14:59: 4	438	334	4	14:59: 5	437	335	4
14:59: 6	439	336	4	14:59: 6	439	336	5	14:59: 7	440	337	5	14:59: 8	441	338	5
14:59: 9	442	339	5	14:59: 9	442	339	4	14:59:10	442	340	5	14:59:11	444	340	4
14:59:12	444	341	4	14:59:12	445	341	4	14:59:13	445	341	4	14:59:14	446	342	4
14:59:15	447	342	4	14:59:15	447	343	4	14:59:16	447	342	4	14:59:17	449	344	4
14:59:18	450	345	4	14:59:18	451	345	4	14:59:19	452	346	4	14:59:20	453	347	4
14:59:21	454	347	4	14:59:21	454	347	4	14:59:22	455	348	4	14:59:23	455	349	4
14:59:24	456	349	4	14:59:24	456	349	4	14:59:25	457	349	4	14:59:26	457	350	4
14:59:27	457	350	4	14:59:27	457	350	4	14:59:28	459	351	4	14:59:29	459	351	4
14:59:30	460	352	4	14:59:30	461	353	4	14:59:31	462	354	4	14:59:32	462	354	5
14:59:33	462	355	5	14:59:33	462	355	7	14:59:34	463	356	7	14:59:35	464	356	7
14:59:36	464	357	9	14:59:36	465	358	9	14:59:37	465	358	9	14:59:38	465	359	10
14:59:39	466	360	10	14:59:39	467	360	10	14:59:40	467	360	12	14:59:41	468	361	12
14:59:42	468	361	12	14:59:42	469	362	12	14:59:43	469	362	12	14:59:44	470	362	12
14:59:45	471	363	12	14:59:45	472	364	12	14:59:46	473	364	12	14:59:47	475	365	14
14:59:48	476	365	14	14:59:48	477	366	14	14:59:49	477	365	14	14:59:50	479	367	14
14:59:51	479	368	14	14:59:51	480	369	14	14:59:52	481	369	14	14:59:53	482	370	14
14:59:54	482	371	14	14:59:54	483	372	14	14:59:55	484	372	14	14:59:56	485	373	14
14:59:57	485	374	14	14:59:57	485	374	14	14:59:58	486	374	14	14:59:59	486	375	14
15: 0: 0	487	375	14	15: 0: 0	487	376	14	15: 0: 1	487	375	14	15: 0: 2	489	377	14
15: 0: 3	489	378	12	15: 0: 3	490	378	12	15: 0: 4	491	379	12	15: 0: 5	491	380	14
15: 0: 6	492	380	12	15: 0: 6	492	380	14	15: 0: 7	493	381	14	15: 0: 8	494	382	12
15: 0: 9	495	382	12	15: 0: 9	495	383	12	15: 0:10	496	383	12	15: 0:11	497	384	12
15: 0:12	497	384	12	15: 0:12	497	384	12	15: 0:13	499	385	12	15: 0:14	499	385	12
15: 0:15	500	386	12	15: 0:15	501	387	12	15: 0:16	501	387	12	15: 0:17	502	387	12
15: 0:18	503	389	12	15: 0:18	503	389	12	15: 0:19	504	390	12	15: 0:20	505	390	12
15: 0:21	505	391	12	15: 0:21	506	392	12	15: 0:22	506	392	12	15: 0:23	507	392	12
15: 0:24	507	393	10	15: 0:24	508	393	10	15: 0:25	508	394	10	15: 0:26	509	394	10
15: 0:27	509	394	10	15: 0:27	510	394	10	15: 0:28	510	395	10	15: 0:29	510	395	10
15: 0:30	511	396	10	15: 0:30	512	396	10	15: 0:31	512	397	10	15: 0:32	513	398	10
15: 0:33	513	399	10	15: 0:33	514	399	9	15: 0:34	514	400	9	15: 0:35	515	400	9
15: 0:36	516	401	9	15: 0:36	517	401	9	15: 0:37	518	401	9	15: 0:38	520	402	9
15: 0:39	521	402	9	15: 0:39	522	403	9	15: 0:40	522	402	9	15: 0:41	523	404	9
15: 0:42	524	405	9	15: 0:42	524	406	9	15: 0:43	525	407	9	15: 0:44	525	408	9
15: 0:45	525	409	9	15: 0:45	525	409	9	15: 0:46	527	410	9	15: 0:47	528	410	9
15: 0:48	529	411	9	15: 0:48	529	411	7	15: 0:49	530	412	7	15: 0:50	531	412	7
15: 0:51	532	412	7	15: 0:51	532	412	7	15: 0:52	533	414	7	15: 0:53	533	414	7

Table 2e. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 5 over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
15: 0:54	534	415	7	15: 0:54	535	415	7	15: 0:55	536	416	7	15: 0:56	536	416	7
15: 0:57	537	417	7	15: 0:57	537	417	7	15: 0:58	538	418	5	15: 0:59	538	418	5
15: 1: 0	539	419	5	15: 1: 0	540	420	5	15: 1: 1	540	420	5	15: 1: 2	540	420	5
15: 1: 3	542	421	5	15: 1: 3	542	422	5	15: 1: 4	543	422	5	15: 1: 5	543	423	5
15: 1: 6	544	423	5	15: 1: 6	545	424	5	15: 1: 7	545	424	4	15: 1: 8	545	425	4
15: 1: 9	547	425	5	15: 1: 9	548	426	4	15: 1:10	549	426	4	15: 1:11	549	427	4
15: 1:12	550	427	4	15: 1:12	551	428	4	15: 1:13	552	427	4	15: 1:14	552	428	4
15: 1:15	552	429	4	15: 1:15	553	429	4	15: 1:16	553	430	4	15: 1:17	553	430	4
15: 1:18	553	431	4	15: 1:18	554	431	4	15: 1:19	554	432	4	15: 1:20	555	433	4
15: 1:21	555	433	4	15: 1:21	555	434	4	15: 1:22	556	435	4	15: 1:23	556	435	4
15: 1:24	557	436	4	15: 1:24	557	436	4	15: 1:25	557	437	4	15: 1:26	559	437	4
15: 1:27	561	438	4	15: 1:27	562	438	4	15: 1:28	564	438	4	15: 1:29	565	439	4
15: 1:30	567	439	4	15: 1:30	567	439	4	15: 1:31	568	440	4	15: 1:32	568	441	4
15: 1:33	569	442	4	15: 1:33	569	442	4	15: 1:34	570	443	4	15: 1:35	570	444	4
15: 1:36	570	445	4	15: 1:36	570	445	4	15: 1:37	572	446	4	15: 1:38	573	446	5
15: 1:39	574	447	5	15: 1:39	575	448	5	15: 1:40	576	448	7	15: 1:41	577	449	7
15: 1:42	578	449	7	15: 1:42	578	450	7	15: 1:43	579	450	9	15: 1:44	580	450	9
15: 1:45	580	450	9	15: 1:45	581	450	9	15: 1:46	581	451	9	15: 1:47	582	450	9
15: 1:48	583	451	9	15: 1:48	583	452	9	15: 1:49	584	452	9	15: 1:50	585	452	9
15: 1:51	585	453	9	15: 1:51	586	453	9	15: 1:52	586	454	9	15: 1:53	587	454	9
15: 1:54	588	454	9	15: 1:54	589	455	9	15: 1:55	590	455	9	15: 1:56	590	455	9
15: 1:57	591	455	7	15: 1:57	592	456	7	15: 1:58	592	455	7	15: 1:59	594	456	7
15: 2: 0	595	456	7	15: 2: 0	596	456	7	15: 2: 1	596	455	5	15: 2: 2	597	455	5
15: 2: 3	598	455	5	15: 2: 3	599	455	5	15: 2: 4	600	455	4	15: 2: 5	601	455	4
15: 2: 6	602	455	4	15: 2: 6	603	455	4	15: 2: 7	604	455	4	15: 2: 8	605	455	4

Table 2e. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 5 over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
15:11:29	510	167	4	15:11:30	510	168	4	15:11:30	509	169	4	15:11:31	508	169	4
15:11:32	507	169	4	15:11:33	507	170	4	15:11:33	506	170	4	15:11:34	505	171	4
15:11:35	504	171	4	15:11:36	503	172	4	15:11:36	503	173	4	15:11:37	502	174	4
15:11:38	502	174	4	15:11:39	501	175	4	15:11:39	501	176	4	15:11:40	500	177	4
15:11:41	500	177	4	15:11:42	500	179	4	15:11:42	499	179	4	15:11:43	499	180	4
15:11:44	499	181	4	15:11:45	499	182	4	15:11:45	498	182	4	15:11:46	497	182	4
15:11:47	497	183	4	15:11:48	497	184	4	15:11:48	496	184	4	15:11:49	495	184	5
15:11:50	495	185	5	15:11:51	494	185	5	15:11:51	494	186	5	15:11:52	492	186	5
15:11:53	493	187	5	15:11:54	492	188	5	15:11:54	492	189	7	15:11:55	492	190	7
15:11:56	491	191	7	15:11:57	490	192	7	15:11:57	490	192	7	15:11:58	491	193	7
15:11:59	490	193	9	15:12: 0	490	194	9	15:12: 0	489	195	9	15:12: 1	489	196	9
15:12: 2	488	196	9	15:12: 3	487	197	9	15:12: 3	487	197	9	15:12: 4	488	198	9
15:12: 5	487	198	9	15:12: 6	487	199	9	15:12: 6	486	200	10	15:12: 7	486	201	10
15:12: 8	485	201	10	15:12: 9	485	202	10	15:12: 9	485	202	10	15:12:10	484	203	10
15:12:11	484	203	10	15:12:12	483	204	10	15:12:12	483	205	10	15:12:13	482	205	12
15:12:14	482	206	12	15:12:15	482	207	12	15:12:15	481	207	12	15:12:16	481	208	12
15:12:17	480	209	12	15:12:18	480	210	12	15:12:18	480	210	14	15:12:19	479	211	14
15:12:20	479	212	14	15:12:21	478	212	14	15:12:21	478	213	14	15:12:22	477	213	14
15:12:23	477	213	14	15:12:24	476	213	14	15:12:24	476	214	14	15:12:25	475	213	14
15:12:26	474	215	15	15:12:27	474	216	15	15:12:27	473	217	15	15:12:28	473	218	15
15:12:29	472	220	15	15:12:30	472	221	15	15:12:30	471	222	15	15:12:31	470	222	16
15:12:32	471	223	16	15:12:33	470	224	16	15:12:33	470	224	16	15:12:34	469	224	16
15:12:35	469	225	16	15:12:36	469	225	16	15:12:36	468	226	16	15:12:37	467	226	18
15:12:38	467	227	18	15:12:39	467	228	18	15:12:39	466	228	18	15:12:40	466	229	18
15:12:41	465	230	18	15:12:42	465	231	18	15:12:42	465	231	18	15:12:43	465	232	18
15:12:44	464	232	18	15:12:45	464	233	19	15:12:45	463	234	19	15:12:46	463	235	19
15:12:47	462	235	19	15:12:48	462	236	19	15:12:48	462	236	19	15:12:49	461	237	19
15:12:50	460	237	19	15:12:51	460	238	19	15:12:51	459	239	19	15:12:52	458	239	19
15:12:53	457	240	19	15:12:54	457	241	19	15:12:54	456	241	19	15:12:55	456	242	19
15:12:56	456	242	19	15:12:57	456	243	19	15:12:57	455	244	19	15:12:58	455	244	19
15:12:59	455	245	19	15:13: 0	455	246	19	15:13: 0	454	246	19	15:13: 1	454	247	18
15:13: 2	453	247	18	15:13: 3	453	248	18	15:13: 3	453	249	18	15:13: 4	452	249	16
15:13: 5	452	250	16	15:13: 6	452	251	16	15:13: 6	451	251	15	15:13: 7	451	252	15
15:13: 8	450	252	14	15:13: 9	450	253	14	15:13: 9	449	253	12	15:13:10	449	253	12
15:13:11	448	254	10	15:13:12	448	255	10	15:13:12	447	255	9	15:13:13	447	256	9
15:13:14	446	256	9	15:13:15	445	257	9	15:13:15	445	257	10	15:13:16	444	257	10
15:13:17	444	259	12	15:13:18	443	260	12	15:13:18	443	261	12	15:13:19	443	263	12
15:13:20	442	264	14	15:13:21	442	265	12	15:13:21	442	265	12	15:13:22	441	266	12
15:13:23	441	266	10	15:13:24	440	267	9	15:13:24	439	268	9	15:13:25	438	269	7
15:13:26	438	269	5	15:13:27	437	270	5	15:13:27	437	270	4	15:13:28	436	270	5
15:13:29	436	271	4	15:13:30	435	271	7	15:13:30	434	272	7	15:13:31	433	272	7
15:13:32	433	273	7	15:13:33	432	272	5	15:13:33	432	272	5	15:13:34	432	274	4
15:13:35	431	275	4	15:13:36	431	276	4	15:13:36	431	277	4	15:13:37	430	278	4
15:13:38	430	278	4	15:13:39	429	279	4	15:13:39	429	280	4	15:13:40	428	280	4
15:13:41	427	280	4	15:13:42	427	281	4	15:13:42	426	281	4	15:13:43	426	282	4
15:13:44	425	282	4	15:13:45	425	283	4	15:13:45	424	283	4	15:13:46	424	284	4
15:13:47	423	285	4	15:13:48	423	286	4	15:13:48	422	286	4	15:13:49	422	287	4
15:13:50	421	288	4	15:13:51	421	288	4	15:13:51	420	289	7	15:13:52	420	290	7
15:13:53	419	290	4	15:13:54	419	291	4	15:13:54	418	291	4	15:13:55	417	292	10
15:13:56	418	292	14	15:13:57	417	293	16	15:13:57	417	293	18	15:13:58	417	293	19

Table 2f. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 6 over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
15:13:59	417	294	18	15:14: 0	416	294	18	15:14: 0	416	295	15	15:14: 1	415	295	10
15:14: 2	415	295	4	15:14: 3	414	296	5	15:14: 3	412	296	14	15:14: 4	411	297	16
15:14: 5	410	297	18	15:14: 6	409	297	18	15:14: 6	408	297	16	15:14: 7	408	299	14
15:14: 8	408	300	7	15:14: 9	407	301	4	15:14: 9	406	303	5	15:14:10	405	304	7
15:14:11	405	305	7	15:14:12	404	306	7	15:14:12	404	306	12	15:14:13	404	307	18
15:14:14	403	308	21	15:14:15	403	308	22	15:14:15	403	309	23	15:14:16	402	310	23
15:14:17	402	311	22	15:14:18	401	311	21	15:14:18	401	312	18	15:14:19	400	312	16
15:14:20	400	312	14	15:14:21	399	313	14	15:14:21	398	313	14	15:14:22	398	314	14
15:14:23	397	313	14	15:14:24	397	315	12	15:14:24	396	315	9	15:14:25	396	316	7
15:14:26	395	316	5	15:14:27	395	317	5	15:14:27	395	318	5	15:14:28	394	318	7
15:14:29	394	318	9	15:14:30	393	319	10	15:14:30	393	320	12	15:14:31	392	320	12
15:14:32	392	321	14	15:14:33	391	321	14	15:14:33	391	322	12	15:14:34	390	322	9
15:14:35	390	323	7	15:14:36	389	323	4	15:14:36	389	324	4	15:14:37	388	325	4
15:14:38	388	325	5	15:14:39	388	326	7	15:14:39	387	326	7	15:14:40	387	327	9
15:14:41	386	328	7	15:14:42	385	329	7	15:14:42	385	329	5	15:14:43	384	330	4
15:14:44	383	331	4	15:14:45	382	332	4	15:14:45	382	332	4	15:14:46	382	332	4
15:14:47	381	333	4	15:14:48	381	333	5	15:14:48	381	334	5	15:14:49	381	334	7
15:14:50	380	335	7	15:14:51	380	335	7	15:14:51	380	335	7	15:14:52	379	336	5
15:14:53	378	336	7	15:14:54	377	337	5	15:14:54	377	337	4	15:14:55	376	338	5
15:14:56	375	338	4	15:14:57	374	339	4	15:14:57	374	339	4	15:14:58	373	340	4
15:14:59	373	341	4	15:15: 0	372	342	4	15:15: 0	371	344	4	15:15: 1	371	345	4
15:15: 2	370	345	4	15:15: 3	370	346	4	15:15: 3	369	347	4	15:15: 4	369	347	4
15:15: 5	368	348	4	15:15: 6	368	348	4	15:15: 6	368	349	4	15:15: 7	367	349	4
15:15: 8	367	350	4	15:15: 9	366	351	4	15:15: 9	366	351	4	15:15:10	365	352	4
15:15:11	365	352	4	15:15:12	364	353	4	15:15:12	364	353	4	15:15:13	362	354	5
15:15:14	362	355	5	15:15:15	362	355	5	15:15:15	361	356	7	15:15:16	361	357	5
15:15:17	360	357	5	15:15:18	360	358	5	15:15:18	360	358	5	15:15:19	359	359	5
15:15:20	358	359	4	15:15:21	358	360	4	15:15:21	357	360	4	15:15:22	357	360	4
15:15:23	356	361	4	15:15:24	356	361	4	15:15:24	355	362	4	15:15:25	355	362	4
15:15:26	354	363	4	15:15:27	354	364	4	15:15:27	353	364	4	15:15:28	353	365	4
15:15:29	352	366	4	15:15:30	352	367	4	15:15:30	352	367	4	15:15:31	351	367	4
15:15:32	351	368	4	15:15:33	350	368	4	15:15:33	350	369	4	15:15:34	349	369	4
15:15:35	349	370	4	15:15:36	347	370	4	15:15:36	347	370	4	15:15:37	348	371	4
15:15:38	347	372	4	15:15:39	347	372	4	15:15:39	347	373	4	15:15:40	346	374	4
15:15:41	345	375	4	15:15:42	345	375	4	15:15:42	345	376	4	15:15:43	344	376	4
15:15:44	343	377	4	15:15:45	343	377	4	15:15:45	342	378	4	15:15:46	342	378	4
15:15:47	340	379	4	15:15:48	341	380	4	15:15:48	340	381	4	15:15:49	340	382	4
15:15:50	339	383	4	15:15:51	339	384	4	15:15:51	339	385	4	15:15:52	338	386	4
15:15:53	337	387	4	15:15:54	338	388	4	15:15:54	338	389	5	15:15:55	338	390	5
15:15:56	338	390	5	15:15:57	338	391	7	15:15:57	338	392	7	15:15:58	337	392	9
15:15:59	338	393	9	15:16: 0	338	394	9	15:16: 0	338	394	9	15:16: 1	338	395	9
15:16: 2	338	395	9	15:16: 3	338	396	9	15:16: 3	338	396	9	15:16: 4	337	397	9
15:16: 5	338	398	9	15:16: 6	338	399	9	15:16: 6	338	400	7	15:16: 7	339	401	7
15:16: 8	339	402	5	15:16: 9	339	402	4	15:16: 9	339	402	4	15:16:10	339	404	4
15:16:11	340	404	4	15:16:12	340	405	4	15:16:12	340	406	4	15:16:13	340	407	4
15:16:14	341	407	4	15:16:15	340	407	4	15:16:15	340	407	4				

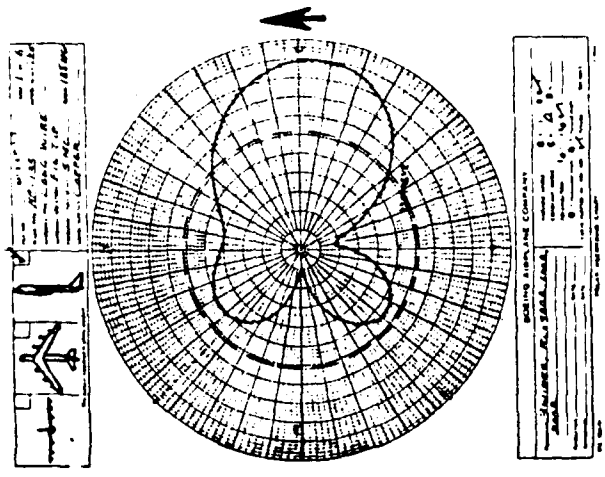
Table 2f. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 6 over the heater antenna. LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7" LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3" A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
15:21:34	432	415	4	15:21:34	432	415	4	15:21:35	432	416	4	15:21:36	431	415	4
15:21:37	431	415	4	15:21:37	430	414	4	15:21:38	430	414	4	15:21:39	429	413	4
15:21:40	429	412	4	15:21:40	429	412	4	15:21:41	429	411	4	15:21:42	428	410	4
15:21:43	428	408	4	15:21:43	428	406	4	15:21:44	427	405	4	15:21:45	427	402	4
15:21:46	427	402	4	15:21:46	426	402	4	15:21:47	426	401	4	15:21:48	425	400	4
15:21:49	425	400	4	15:21:49	425	399	4	15:21:50	424	399	4	15:21:51	424	397	4
15:21:52	424	397	4	15:21:52	424	397	4	15:21:53	424	396	4	15:21:54	423	395	4
15:21:55	423	395	4	15:21:55	423	394	4	15:21:56	423	394	4	15:21:57	422	392	4
15:21:58	423	392	4	15:21:58	422	392	4	15:21:59	422	391	4	15:22: 0	422	390	4
15:22: 1	422	389	4	15:22: 1	421	389	4	15:22: 2	420	387	4	15:22: 3	421	387	4
15:22: 4	420	387	4	15:22: 4	420	386	4	15:22: 5	419	385	4	15:22: 6	419	385	4
15:22: 7	419	384	5	15:22: 7	418	384	5	15:22: 8	417	382	5	15:22: 9	417	382	7
15:22:10	417	382	7	15:22:10	416	381	9	15:22:11	416	380	9	15:22:12	415	380	9
15:22:13	415	379	9	15:22:13	415	379	7	15:22:14	414	378	7	15:22:15	414	377	7
15:22:16	413	376	5	15:22:16	413	376	4	15:22:17	412	375	4	15:22:18	412	374	4
15:22:19	410	372	4	15:22:19	410	372	5	15:22:20	411	372	9	15:22:21	410	371	12
15:22:22	410	370	14	15:22:22	410	370	15	15:22:23	410	369	19	15:22:24	409	368	18
15:22:25	409	367	19	15:22:25	409	367	21	15:22:26	409	366	22	15:22:27	409	366	22
15:22:28	409	365	23	15:22:28	408	365	23	15:22:29	408	364	25	15:22:30	408	364	25
15:22:31	407	362	25	15:22:31	407	362	27	15:22:32	408	361	27	15:22:33	408	360	27
15:22:34	408	358	27	15:22:34	408	357	28	15:22:35	408	355	28	15:22:36	407	354	28
15:22:37	408	353	28	15:22:37	408	352	28	15:22:38	408	351	28	15:22:39	408	351	30
15:22:40	408	350	28	15:22:40	408	349	30	15:22:41	407	347	30	15:22:42	408	347	30
15:22:43	408	346	30	15:22:43	408	346	30	15:22:44	408	345	30	15:22:45	408	344	28
15:22:46	408	343	28	15:22:46	408	343	30	15:22:47	407	342	28	15:22:48	408	341	28
15:22:49	408	340	28	15:22:49	408	340	28	15:22:50	408	339	28	15:22:51	408	338	28
15:22:52	408	337	27	15:22:52	408	337	27	15:22:53	407	335	27	15:22:54	408	335	27
15:22:55	408	335	25	15:22:55	408	334	25	15:22:56	408	333	23	15:22:57	408	333	23
15:22:58	407	332	22	15:22:58	407	332	21	15:22:59	408	331	19	15:23: 0	408	330	18
15:23: 1	408	329	15	15:23: 1	407	328	14	15:23: 2	407	327	14	15:23: 3	407	326	15
15:23: 4	407	325	16	15:23: 4	407	325	18	15:23: 5	407	324	19	15:23: 6	407	323	19
15:23: 7	407	322	19	15:23: 7	407	322	19	15:23: 8	407	321	19	15:23: 9	407	320	19
15:23:10	407	319	18	15:23:10	407	318	18	15:23:11	407	318	16	15:23:12	407	317	15
15:23:13	407	316	14	15:23:13	407	315	12	15:23:14	407	315	12	15:23:15	407	313	14
15:23:16	407	314	15	15:23:16	407	313	15	15:23:17	407	313	16	15:23:18	407	312	18
15:23:19	407	312	16	15:23:19	407	312	16	15:23:20	407	311	16	15:23:21	407	311	16
15:23:22	407	309	15	15:23:22	407	308	14	15:23:23	407	306	10	15:23:24	408	305	9
15:23:25	408	303	5	15:23:25	408	302	9	15:23:26	407	300	12	15:23:27	408	299	15
15:23:28	408	298	18	15:23:28	408	298	19	15:23:29	407	297	22	15:23:30	407	296	22
15:23:31	407	295	23	15:23:31	407	295	25	15:23:32	407	293	25	15:23:33	407	293	25
15:23:34	407	292	25	15:23:34	407	291	25	15:23:35	408	290	25	15:23:36	408	289	23
15:23:37	407	287	22	15:23:37	407	287	21	15:23:38	408	287	18	15:23:39	408	286	15
15:23:40	408	285	12	15:23:40	407	285	12	15:23:41	407	284	14	15:23:42	407	283	16
15:23:43	407	282	18	15:23:43	407	282	19	15:23:44	407	281	19	15:23:45	407	281	19
15:23:46	407	280	19	15:23:46	407	280	19	15:23:47	407	279	18	15:23:48	407	279	16
15:23:49	407	277	15	15:23:49	407	277	15	15:23:50	407	277	16	15:23:51	407	276	18
15:23:52	407	274	19	15:23:52	407	273	21	15:23:53	407	272	22	15:23:54	407	271	22
15:23:55	407	270	23	15:23:55	406	270	23	15:23:56	406	269	23	15:23:57	406	268	22
15:23:58	406	268	22	15:23:58	405	267	21	15:23:59	405	267	19	15:24: 0	405	266	18
15:24: 1	405	265	16	15:24: 1	406	264	15	15:24: 2	406	263	14	15:24: 3	406	263	16

Table 2g. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 7 over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.

TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A	TIME	LO	LA	A
15:24: 4	406	262	18	15:24: 4	407	261	21	15:24: 5	407	260	22	15:24: 6	407	260	23
15:24: 7	407	259	25	15:24: 7	407	259	27	15:24: 8	407	258	27	15:24: 9	407	258	28
15:24:10	407	258	28	15:24:10	407	257	28	15:24:11	407	257	28	15:24:12	407	256	30
15:24:13	406	254	30	15:24:13	406	253	30	15:24:14	406	251	30	15:24:15	406	250	30
15:24:16	405	249	30	15:24:16	405	247	30	15:24:17	405	246	30	15:24:18	405	245	30
15:24:19	405	244	28	15:24:19	405	243	28	15:24:20	405	243	28	15:24:21	405	242	28
15:24:22	405	241	28	15:24:22	405	241	28	15:24:23	405	240	28	15:24:24	405	239	27
15:24:25	405	238	27	15:24:25	405	237	27	15:24:26	405	236	27	15:24:27	405	235	25
15:24:28	405	233	25	15:24:28	405	233	25	15:24:29	405	233	23	15:24:30	405	232	23
15:24:31	405	231	23	15:24:31	405	231	22	15:24:32	405	230	22	15:24:33	405	228	22
15:24:34	405	228	21	15:24:34	405	227	21	15:24:35	405	227	19	15:24:36	405	226	19
15:24:37	405	225	18	15:24:37	405	224	18	15:24:38	405	224	18	15:24:39	405	222	16
15:24:40	405	222	16	15:24:40	405	221	15	15:24:41	405	221	14	15:24:42	405	220	14
15:24:43	405	219	14	15:24:43	405	218	12	15:24:44	405	218	12	15:24:45	405	217	10
15:24:46	405	216	10	15:24:46	405	215	9	15:24:47	405	214	9	15:24:48	404	214	7
15:24:49	404	213	7	15:24:49	404	212	5	15:24:50	404	211	5	15:24:51	404	210	4
15:24:52	404	209	4	15:24:52	404	209	4	15:24:53	404	208	4	15:24:54	404	207	4
15:24:55	404	206	4	15:24:55	404	206	4	15:24:56	404	205	4	15:24:57	404	205	4
15:24:58	404	204	4	15:24:58	404	204	4	15:24:59	404	204	4	15:25: 0	404	203	4
15:25: 1	404	202	4	15:25: 1	404	202	4	15:25: 2	404	201	4	15:25: 3	404	200	4
15:25: 4	404	198	4	15:25: 4	404	197	4	15:25: 5	404	195	4	15:25: 6	404	194	4
15:25: 7	404	192	4	15:25: 7	404	192	4	15:25: 8	404	191	4	15:25: 9	404	190	4
15:25:10	404	189	4	15:25:10	404	189	4	15:25:11	404	188	4	15:25:12	404	187	4
15:25:13	404	186	4	15:25:13	404	186	4	15:25:14	404	185	4	15:25:15	404	184	4
15:25:16	404	182	4	15:25:16	404	181	4	15:25:17	404	180	4	15:25:18	404	178	4
15:25:19	404	178	4	15:25:19	404	178	4	15:25:20	404	177	4	15:25:21	404	177	4
15:25:22	404	176	4	15:25:22	404	176	4	15:25:23	404	175	4	15:25:24	404	175	4
15:25:25	404	174	4	15:25:25	404	174	4	15:25:26	404	173	4	15:25:27	404	172	4
15:25:28	404	171	4	15:25:28	404	171	4	15:25:29	404	170	4	15:25:30	404	169	4
15:25:31	404	168	4	15:25:31	404	168	4	15:25:32	403	167	4	15:25:33	403	166	4
15:25:34	403	165	4	15:25:34	403	165	4	15:25:35	402	163	4	15:25:36	403	163	5
15:25:37	403	162	5	15:25:37	403	161	4	15:25:38	403	160	5	15:25:39	403	160	5
15:25:40	403	159	5	15:25:40	403	158	5	15:25:41	402	156	5	15:25:42	403	156	5
15:25:43	403	155	5	15:25:43	402	154	5	15:25:44	402	153	5	15:25:45	402	152	7
15:25:46	40	151	5	15:25:46	402	151	7	15:25:47	401	151	7	15:25:48	401	150	7
15:25:49	400	150	5	15:25:49	400	149	5	15:25:50	399	149	5	15:25:51	399	148	5
15:25:52	397	148	5	15:25:52	397	148	4	15:25:53	398	146	4	15:25:54	397	145	4
15:25:55	397	143	4	15:25:55	397	142	4	15:25:56	396	140	4	15:25:57	395	138	4

Table 2g. Amplitude in dB vs aircraft coordinates and Universal Time for flight track 7 over the heater antenna.
LO = longitude in 0.1 minutes at 66° e.g. 397 is 66°39.7"
LA = latitude in 0.1 minutes at 18° e.g. 213 is 18°21.3"
A = scaled amplitude in dB.



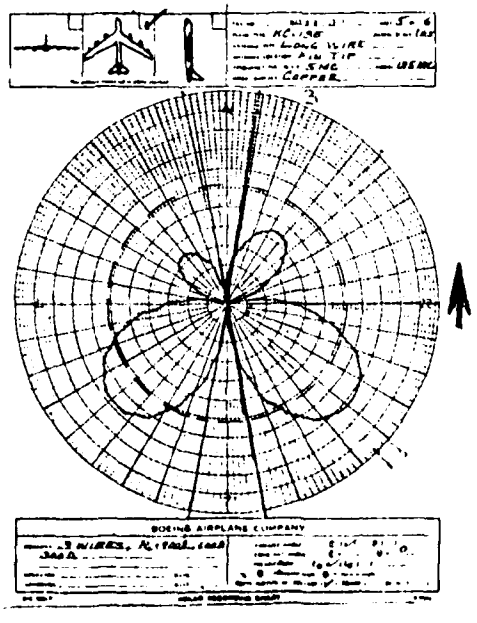


Figure 10. Aircraft radiation pattern from scale model measurements. a. In vertical plane (α = 0°) of aircraft. b. In horizontal plane of aircraft.

4.0 INTERPRETATION OF THE MEASUREMENTS

For those flight paths directly through the major lobes of the heater radiation it suffices to take into account the aircraft pattern in the vertical plane through the aircraft axis (upper part of Figure 10). The situation is sketched in Figure 11. The amplitude ratio between maximum and central minimum of the modeled aircraft pattern is five. The aircraft maximum is almost lining up with the direction of the heater side lobe, which means an amplification factor of five for the side lobe signals compared to the vertical beam. In Figure 3, the theoretical pattern of the track is plotted together with the actual pattern of track 1. The calculated amplitude function in Figure 3 takes into account the range increase (for constant aircraft altitude) with θ as well as the aircraft radiation pattern. This pattern is based on scale model measurements (Figure 10) so no further dipole factor modulation is required. The theoretical curve shows a sharp dip at overhead, due to the aircraft radiation pattern (Figure 10a). When comparing overhead to the side lobes we use an averaged theoretical curve at overhead. This is confirmed by the output of the Digisonde and the Collins R390 receiver. The side lobes are approximately 1.5 dB higher than the main beam. The results of these calculations are summarized in Table 3.

If we look at the measurements for paths 1 and 3 which were flying through the beams in the south-north and east-west directions we find the theoretical predictions to be very good. The measured side lobes are ? dB and 0 dB lower than the central lobe for path 1, and 0 and 2 dB higher for path 3. The theory predicts the side lobes to be between 1 and 2 dB higher. The small difference can be accounted for by the combination of the aircraft position not being directly overhead and the uncertainty of the aircraft radiation pat-

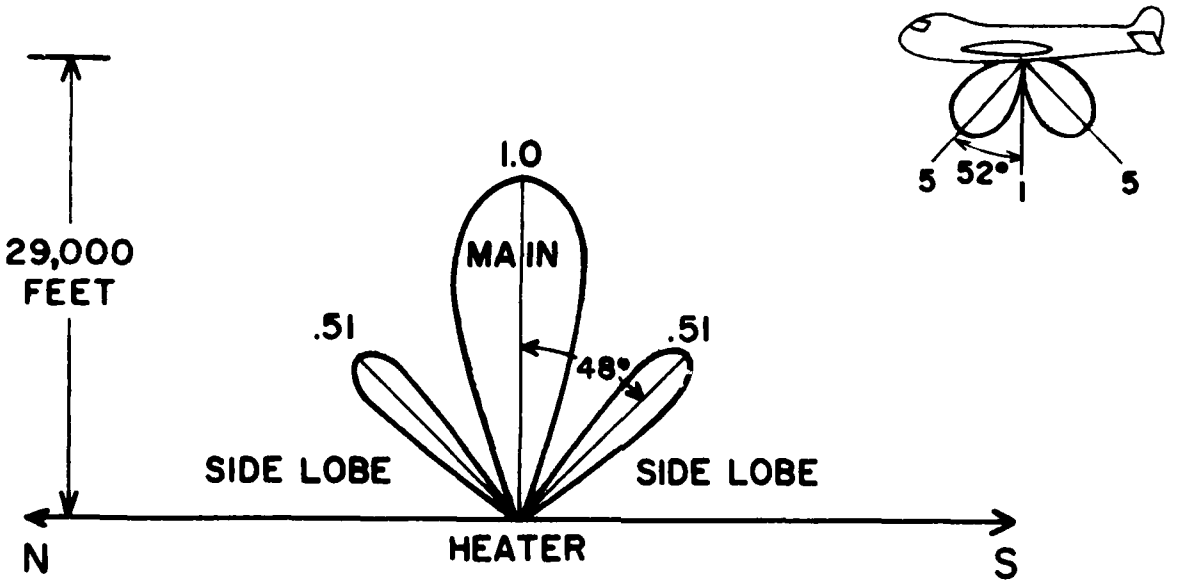


Figure 11. Field strength patterns for heater antenna and aircraft. Numbers at lobes indicate relative amplitude.

DISTANCE [NMI]	RANGE [NMI]	θ [°]	CORRECTED PATTERN [dB]	THEORETICAL PATTERN [dB]	RANGE CORRECTION [dB]	AIRCRAFT PATTERN CORRECTION [dB]
0.00	5.50	0.00	49.34	0.00	0.00	0.00
.10	5.50	1.04	50.77	48.19	-.00	1.58
.20	5.50	2.08	51.00	48.73	-.01	2.28
.30	5.51	3.12	50.84	47.93	-.01	2.92
.40	5.51	4.16	50.26	46.76	-.02	3.52
.50	5.52	5.19	49.18	45.15	-.04	4.08
.60	5.53	6.23	46.98	42.96	-.05	4.08
.70	5.54	7.25	44.47	39.93	-.07	4.61
.80	5.56	8.28	40.43	35.41	-.09	5.11
.90	5.57	9.29	32.27	26.81	-.11	5.58
1.00	5.59	10.30	26.13	20.25	-.14	6.02
1.10	5.61	11.31	37.48	31.22	-.17	6.44
1.20	5.63	12.31	41.55	34.90	-.20	6.85
1.30	5.65	13.30	43.97	36.80	-.24	7.60
1.40	5.69	14.28	44.90	37.22	-.27	7.96
1.50	5.70	15.26	45.36	37.04	-.31	8.63
1.60	5.73	16.22	44.73	36.14	-.35	8.94
1.70	5.76	17.18	43.29	34.44	-.40	9.25
1.80	5.79	18.12	40.74	31.64	-.44	9.54
1.90	5.82	19.06	36.09	26.75	-.49	9.83
2.00	5.85	19.98	23.11	13.54	-.54	10.10
2.10	5.89	20.90	31.15	21.37	-.59	10.37
2.20	5.92	21.80	38.50	28.51	-.64	10.63
2.30	5.96	22.69	42.06	31.88	-.70	10.88
2.40	6.00	23.57	44.18	33.81	-.76	11.13
2.50	6.04	24.44	45.45	34.91	-.82	11.36
2.60	6.08	25.30	46.11	35.39	-.88	11.60
2.70	6.13	26.15	46.26	35.38	-.94	11.82
2.80	6.17	26.98	45.93	34.89	-1.00	12.04
2.90	6.22	27.80	45.07	33.88	-1.07	12.26
3.00	6.26	28.61	43.58	32.24	-1.13	12.46
3.10	6.31	29.41	40.84	29.67	-1.20	12.46
3.20	6.36	30.19	36.71	25.31	-1.27	12.67
3.30	6.41	30.96	25.90	14.57	-1.34	12.67
3.40	6.47	31.72	29.87	18.40	-1.41	12.87
3.50	6.52	32.47	38.31	26.92	-1.48	12.87
3.60	6.57	33.21	42.60	31.09	-1.55	13.06
3.70	6.63	33.93	45.24	33.80	-1.62	13.06
3.80	6.69	34.64	47.13	35.76	-1.69	13.06
3.90	6.74	35.34	48.72	37.24	-1.77	13.26
4.00	6.80	36.03	49.79	38.38	-1.84	13.26

Table 3. Theoretical antenna pattern with corrections for aircraft pattern and range. Distance is from aircraft to overhead, range is from heater antenna to aircraft, θ is zenith angle from overhead.

DISTANCE [NMI]	RANGE [NMI]	θ [°]	CORRECTED PATTERN [dB]	THEORETICAL PATTERN [dB]	RANGE CORRECTION [dB]	AIRCRAFT PATTERN CORRECTION [dB]
4.10	6.86	36.70	50.61	39.28	-1.92	13.26
4.20	6.92	37.37	51.42	39.88	-2.00	13.44
4.30	6.98	38.02	51.89	40.52	-2.07	13.44
4.40	7.04	38.66	52.22	40.82	-2.15	13.44
4.50	7.11	39.29	52.43	41.22	-2.23	13.44
4.60	7.17	39.91	52.73	41.41	-2.30	13.62
4.70	7.23	40.52	52.77	41.52	-2.38	13.62
4.80	7.30	41.11	52.72	41.56	-2.46	13.62
4.90	7.37	41.70	52.61	41.52	-2.54	13.62
5.00	7.43	42.27	52.62	41.43	-2.62	13.80
5.10	7.50	42.84	52.39	41.28	-2.69	13.80
5.20	7.57	43.39	52.11	41.08	-2.77	13.80
5.30	7.64	43.94	51.78	40.83	-2.85	13.80
5.40	7.71	44.47	51.41	40.54	-2.93	13.80
5.50	7.78	45.00	51.18	40.21	-3.01	13.98
5.60	7.85	45.52	50.73	39.84	-3.09	13.98
5.70	7.92	46.02	50.25	39.44	-3.17	13.98
5.80	7.99	46.52	49.74	39.01	-3.25	13.98
5.90	8.07	47.01	49.20	38.54	-3.33	13.98
6.00	8.14	47.49	48.62	38.05	-3.40	13.98
6.10	8.21	47.96	48.02	37.53	-3.48	13.98
6.20	8.29	48.42	47.57	36.98	-3.56	14.15
6.30	8.36	48.88	46.91	36.40	-3.64	14.15
6.40	8.44	49.33	46.24	35.80	-3.72	14.15
6.50	8.51	49.76	45.53	35.18	-3.80	14.15
6.60	8.59	50.19	44.81	34.53	-3.87	14.15
6.70	8.67	50.62	44.06	33.86	-3.95	14.15
6.80	8.75	51.03	43.29	33.16	-4.03	14.15
6.90	8.82	51.44	42.49	32.45	-4.11	14.15
7.00	8.90	51.84	41.67	31.70	-4.18	14.15
7.10	8.98	52.24	40.83	30.94	-4.26	14.15
7.20	9.06	52.62	39.96	30.14	-4.34	14.15
7.30	9.14	53.00	38.90	29.33	-4.41	13.98
7.40	9.22	53.38	37.98	28.48	-4.49	13.98
7.50	9.30	53.75	37.03	27.61	-4.56	13.98
7.60	9.38	54.11	36.05	26.71	-4.64	13.98
7.70	9.46	54.46	35.05	25.78	-4.71	13.98
7.80	9.54	54.81	34.00	24.81	-4.79	13.98
7.90	9.63	55.15	32.93	23.81	-4.86	13.98
8.00	9.71	55.49	31.81	22.76	-4.94	13.98

Table 3. Theoretical antenna pattern with corrections for aircraft pattern and range. Distance is from aircraft to overhead, range is from heater antenna to aircraft, θ is zenith angle from overhead.

tern. For path 7 the airplane was at 8° to the west from the vertical north-south plane. This tends to reduce the ratio between maximum and minimum in the aircraft pattern to about 3 (lower part of Figure 10). This should result in side lobe amplitudes of 6 dB above the main lobe. Figure 9 shows the side lobes to be 6 dB stronger than the central beam, as predicted.

The uncertainty of the aircraft radiation pattern prevents a definite evaluation of the relative power radiated in the different beams of the heater antenna array. It appears likely that the calculated patterns are correct. Introduction of a dipole factor for the aircraft pattern would not make the theoretical curve agree any better for Figure 1 and the agreement found for flight tracks 3 and 7 would be lost. With certainty it can be stated that the orientation of the side lobes is as predicted. The number of minor side lobes also seems to verify the calculations. The measured amplitudes of the minor side lobes seems to be somewhat low (Figures 3, 5 and 7). The number and locations of the minor peaks in these figures agree well with the predictions.

In summary, we conclude that the theoretical radiation pattern is a good representation of the actual heater antenna pattern, however, less power than predicted is radiated into the minor side lobes.

5.0 REFERENCES

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